AUGUST 25, 1958 Price 50 cents

RESEARCH and DEVELOPMENT news edition

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT

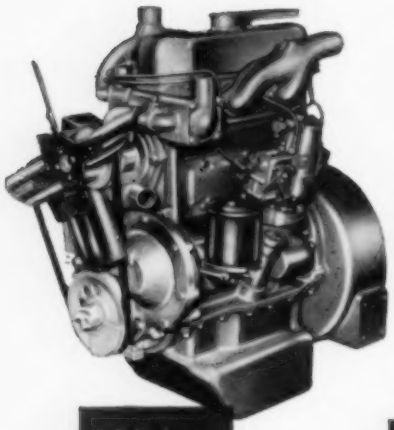
HYPERSONIC GAS GUN

tests two ways . . . see page 14

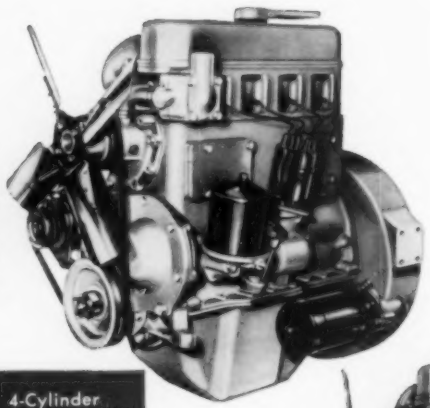
to turn a NOSE CONE . . . see page 26

E B POWER
UNIVERSITY MICROFILMS IN
313 W S ST
ANN ARBOR MICH A

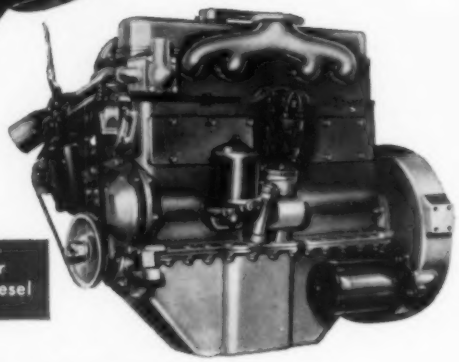
You can power your whole line with *HERCULES* engines



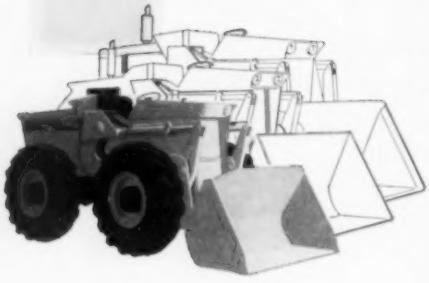
3-Cylinder
Gas or Diesel



4-Cylinder
Gas or Diesel



6-Cylinder
Gas or Diesel



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With three bore sizes in 3, 4, and 6 cylinder models, Hercules new DD diesel and GO gasoline (or LPG) engines offer 18 horsepower ratings from which to choose your power.

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If you'd like more information on specific engine selections for your equipment line, call the Hercules representative near you or write to Hercules Motors Corporation, Canton 2, Ohio.

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Watch for the DESIGN edition for September 1

which will include

Engineering in EUROPE

the editor's impressions of Design and Development in England, France, Italy, Germany, Switzerland and Sweden.

You'll also find these important feature articles in the DESIGN edition for September 1

- **Best results with phenolic molded parts**
  How skillful design is needed when molding thermosetting plastics.

- **Engineering design—basis of modern life**
  Civilization may be in trouble if we let young grads bypass the drawing board.

- **Stresses in press-fit bushings**
  A family of formulas, each for a typical application.

- **14 indexing devices**
  How to position moving parts accurately in one or more locations.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R and D RESEARCH and DEVELOPMENT news edition

August 25, 1958 Vol. 29, No. 34

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Product Engineering ..... SIDELIGHTS

RESEARCH and DEVELOPMENT news edition

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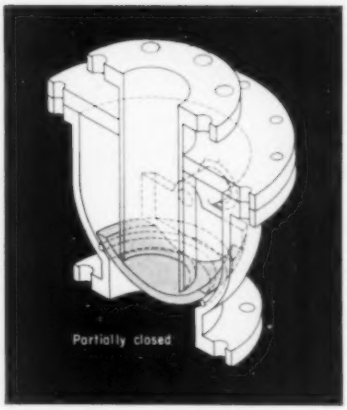

● **Some objects are more three-dimensional** than others. As a matter of fact, most natural objects (a mountain, a waterfall, a lion, Brigitte Bardot) are practically impossible to depict without perspective or some reasonable approximation thereof (p. 22). Man-made products, however, where possible are designed from a base line in two dimensions—and design suffers accordingly. That's why we smiled admiration at the new egg-emptying machine designed by Bosch & Holtes of Amsterdam. The egg, a natural object awkward to handle, is pierced at the top and bottom of stainless-steel needles and the contents blown out by filtered, compressed air. "A fluid takes the shape of its container . . ." so breaking the egg is unnecessary.

● **Artificial satellites** (and their accompanying nose cones—p. 26) are rather like the messages we used to seal up in bottles and toss on the sea. One day we'll get an answer from out there scrawled in some exotic claw-writing and the world will react with shocked surprise. Flying-saucer sightings have been described as balloons, meteors, the planet Venus, ionized air and even mass hysteria. Now Dr. Carl Jung, the eminent psychiatrist, reports that a "purely psychological explanation is ruled out." Someone is watching us—and they don't much care if we know it. Someday one will land the pilot will ask: "which of you is trying to infest us with mice?"

● **"The Little Man Can't Protect His Patents,"** which appeared in the July 28 issue, resulted in a storm of protest (from patent attorneys) and applause (from inventors). One would not suppose that patent law could have two such different interpretations: ". . . an article containing so many inaccuracies and misconceptions," says an attorney; "Bravo! I heartily agree . . ." says an inventor. They'll all be heard, insofar as space permits, in coming issues—their letters will be printed and further articles are already on the way.

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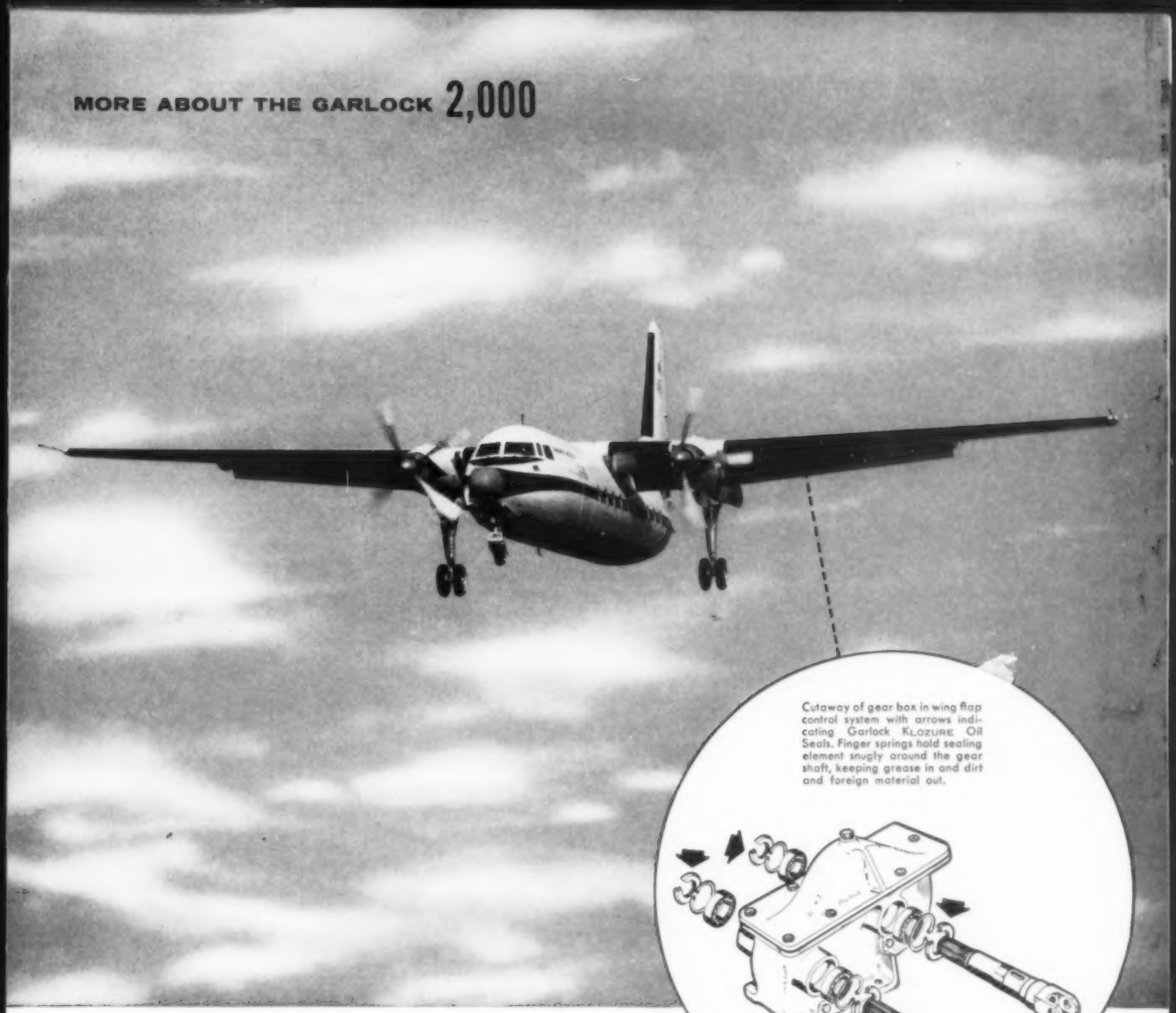

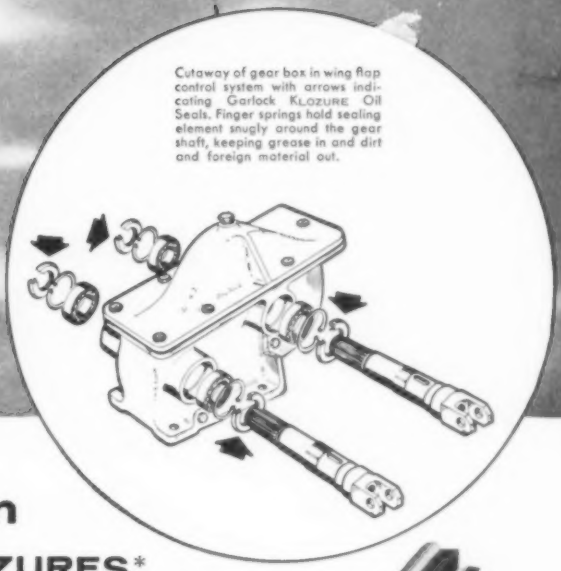

Cutaway of gear box in wing flap control system with arrows indicating Garlock KLOZURE Oil Seals. Finger springs hold sealing element snugly around the gear shaft, keeping grease in and dirt and foreign material out.

F-27 Flap Control System Sealed with Garlock KLOZURES*

Garlock KLOZURE Oil Seals contribute to the superb performance of the new Fairchild F-27 Propjetliner. 36 Garlock KLOZURES are located in 12 gear boxes in the wing flap control system. This system is instrumental in providing exceptional good landing and take-off performance.

The flaps are operated by an electric motor and reduction gear train. A total of 12 gear boxes are driven by means of a torque tube extending across the airplane to the outboard ends of the flaps. KLOZURES seal in the lubricating oil on the shafts providing dependable, trouble-free operation.

Why not let Garlock solve your difficult sealing problems. Your Garlock representative can recommend from "the Garlock 2,000" . . . two thousand different styles of packings, gaskets, and seals for every need. It's the only complete line in the industry. Call him or write for Catalog 20.

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Cross-section of Garlock KLOZURE Model 63 designed for normal and high speed service, and used on the F-27. Exclusive Garlock sealing element is non-abrasive, free-running; resistant to oil, water, grease, heat and cold. Sealing elements of silicone rubber or Viton A for temperature extremes are also obtainable.

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CIRCLE 51 READER SERVICE CARD

READER TO EDITOR

Scores of letters have been received commenting on our issue, "How Moscow Designs," July 14. From these we have taken the extracts below—including the one negative comment, two of the three that caught our mis-statement on patents, and portions of others that add to the picture. Space limitations prohibit publication of the many congratulatory letters which were indeed heartwarming.

Doing the Commies a Favor?

To the Editor:

We do not think much of your red-cover issue devoted to Moscow. It is strictly as your editorial says, "nonpolitical." The editorial does not seem to realize that everything the Communists do—but everything—is political. You advise the reader to be sure to arrange his visit through Intourist (Communist travel agency). This is undoubtedly to keep the visitor strictly under the thumbs of the politicians, who rest assured will give you a guided tour through just what they want you to see, and with the best propaganda possibilities. This special issue inevitably must include a lot of propaganda carefully planted by the Communist politicians. After all Communists are NOT the partners of Americans; they are our enemy. When will we learn that?

—JOHN K. CRIPPEN, VP
L B Allen Co, Inc
Schiller Park, Ill.

To the Editor:

. . . The special issue of PRODUCT ENGINEERING represents an important contribution toward American understanding of the Soviet economy.

—JAMES R. ALDERDICE
Texas Instrument Corp
Dallas, Tex.

To the Editor:

. . . I like your simple reporting style that permits so clear a picture of what you saw —I almost felt I was there. This is what the American engineer wants to know of technical progress in Russia. Whether or not we like the Russian system of government, we should realistically appraise their progress. Let us not be so smug as not to learn from the advance of others. The Russians are certainly taking the best we have produced for their advantage. . .

—MITCHELL FEIN
Hilldale, N. J.

Russian Accomplishments Frightening

To the Editor:

Having lived in Russia (Siberia) for six years as a war prisoner during and following the first world war, I had the opportunity to observe something of Russia's industry, science and engineering. I worked with Russian engineers and other technical personnel on nonmilitary projects. Your Russian issue presents such a fascinating and formidable account of how Moscow designs, the picture of progress to me is almost unbelievable. However, with the documentation that you present, I must believe it. It is somewhat frightening that the Russians have accomplished so much with their system of government.

I am an engineer and manage an industrial plastic custom-fabrication shop. We have been in business for 17 years and have come to rest in the thought that we have contributed to the progress in industry. Your issue is making me re-examine our operation for traces of vitiating smugness.

—FERDINAND T. KEBELY
K-Plastix
San Francisco

Summer School Enrollment Up

To the Editor:

. . . I have heard recently that 15 to 20% more high school students have enrolled for summer school here in Los Angeles than in previous years. If this interest in learning continues it will be good for America. . .

—J. MCCOUGAN
Los Angeles

Patent Mixup

To the Editor:

. . . As a nation I believe we have been misinformed about Russia and we have not kept up with the progress and changes that have taken place in that country. I think Russia and the US have a lot to learn from each other. I am particularly impressed by your report because it confirms my own observations made during the three-week period I spent in Russia last October as a member of the Metallurgical Exchange Delegation.

One minor point I would like to ask you about is your comment on page 2 that the USSR has no patent system. I am under the impression that they did have in operation a patent system similar to that of other European countries.

—J. DONALD HANAWALT, VP
Dow Chemical Co
Midland, Mich.

To the Editor:

Mr. Tangerman states that the USSR has no patent system. Russia does indeed have a patent system which in a few respects at least is superior to ours. What Mr. Tangerman probably meant was that Russia does not have a reciprocal patent agreement with other nations. In other words Russians are not supposed to "borrow" ideas from other Russians without payment but to "borrow" from the rest of the world is permissible. This issue is a fine analysis of Russia and Russian industry. Articles of this type will permit a better understanding between nations.

—CHARLES L. MORSE
South Dartmouth, Mass.

• *Russia does have an internal patent system. It protects its own inventors and rewards them with liberal payment if some other plant decides to use the same design. They are, however, taking foreign patents, particularly in the chemical field, and combining them to produce products and methods superior to our products subject to normal patent limitations. Our thanks to Mr. G. M. Naul who also caught the error.*—EJT

Russian Correspondence

To the Editor:

If the Russians can get American publications, and they do get and study them, why shouldn't Americans receive and study Russian publications? Oh. Americans don't speak Russian! Well, even little Russian children learn Russian so are the intelligent Americans inferior to the Russian children? I received a letter from a 19-year-old Moscovite several months ago but I have not heard from him since. His letter to me was rather unusual but easily understandable: "I have read a lot of books about your country and want to know still more. I believe that only during our personal correspondence we can learn to understand much about our countries. I should be very glad if you can be so kind as to help me in mastering your language and as far as I am concerned I shall be very glad to help you learn Russian. . . . My mother and sister work together with me at the plant. Mother is an engineer and my sister is a controller."

—MERRITT L. PERKINS
Perkins Laboratories
Three Rivers, Mich.

The Blind Men and the Elephant

To the Editor:

. . . My general impression after reading the Russian issue is that we have not been getting a true picture of Russia through our magazines and newspapers. Perhaps it is like the fable about the blind men describing an elephant—so our picture of Russia has been similarly distorted. The general tone of your articles gives one confidence that everything you have written is true and factual without any distortion. . .

—JOSEPH E. SHIPLEY
Associate Professor
University of Mich.

They All Concur

To the Editor:

. . . I enjoyed your presentation immensely and mentally reviewed it with some trepidation and concern. At the same time I was reading John Gunther's *Inside Russia*, and also three or four reports sent back to the Philadelphia *Inquirer* by Mayor Dilworth on his visit to Russia—they all definitely concur. Are our political, financial and industrial leaders closing their minds to the fact that Russian Communists have sworn to conquer the world? Thanks for such excellent coverage and for putting it all in one issue.

—JAY E. CLAIRE
Hercules Powder Co
Wilmington, Del.

American... DEVELOPMENTS TO WATCH...

Copper strip, edge-bonded to steel . . .

. . . by a new process, offers a relatively low-cost combination material for mechanical and electrical use, says Metals Research & Development, Inc. Exeter, Penna. The company says it can turn out strip with any desired ratio of copper to steel, and an over-all strength of 40,000 psi or more.

Film made from foam, but looking and acting . . .

. . . like medium-gage sheeting will soon be introduced by Ludlow Papers, Inc, Needham 94, Mass. This is a polyethylene plastic material, extruded with the foaming agent already in the resin, to produce a translucent or colored material that looks rather like frosted glass and contains tiny, trapped air cells that provide both rigidity and additional insulation value.

Ludlow will offer the polyethylene foam film in sheet, roll, and tape form, in thicknesses from 16 to 20 mils, with a tensile strength of 6,300 to 12,000 psi, for use at temperatures from −100 F to 230 F. The material can be shaped under heat and pressure, and is expected to have structural as well as electrical uses.

Also coming up from Ludlow: a whole new line of clear polyethylene and polypropylene films, made by a new process said to improve heat-sealability and produce a wider range of thicknesses than previously available. A polypropylene foam sheeting is under development too—but not yet ready for commercial introduction.

Techniques that will deposit "any known element . . .

. . . or combination of elements" on a cold base to create a coating of almost any desired thickness are being developed on both East and West Coasts.

At Giannini Plasmadyne Corp, Santa Ana, Calif, the development is an outgrowth of the company's research on missiles and rocket propulsion (*PE—Feb 24, p 14*).

The new technique soon to be unveiled by an East Coast company (but not ready for release as we go to press), stems from a high-temperature coating system announced several years ago, and now greatly modified and extended.

The Giannini process uses an electric arc discharge to produce ultrahigh temperatures (to 25,000 F) and velocities (about 13,000 ft per sec) to vaporize the coating material (tungsten, for instance) and propel it onto the base. Surface bond is said to be excellent; coatings, unusually dense and smooth.

Applications foreseen for the methods include "low cost, lightweight protection" for bearing and pump surfaces operating at high temperature, combustion-chamber valves and liners, high-speed grinding and cutting tools, and high-temperature wire insulation.

Giannini is ready to coat parts on a production basis, to sell equipment, or to license its process to interested manufacturers.

Improved synthetic rubbers . . .

. . . can be made from standard ingredients, says Firestone Tire & Rubber Co, by taking advantage of new catalyst systems developed for man-made "natural" rubber.

Starting with butadiene, one of the basic materials in the general-purpose synthetic, G-R-S, the company says it can turn out a compound blendable with natural rubber to produce tires that show marked improvement in crack and skid resistance, satisfactory resistance to heat build up and good low-temperature pliability. The new material can be produced with the same equipment as Coral rubber (Firestone's isoprene-based man-made "natural" rubber); and the catalyst, in both cases, is a lithium derivative.

Firestone has given the newcomer a name: *Diene*. But no plans have yet been announced for commercial production. —ARG

American ...Washington

DEVELOPMENTS TO WATCH...

Watch the Justice Department's action . . .

on behalf of defense contractors hit by tax suits from state and local tax authorities. Lately, contractors have come under heavy fire from city and state governments claiming real and personal property tax payments from Department of Defense and AEC contractors using Government facilities.

The growing volume of claims stems from a Supreme Court ruling that federal-owned property used by companies for profit is not tax exempt.

Under the provisions of most defense contracts, the companies can pass on the new tax costs to the Federal Government. Lawyers estimate the extra cost may run $250-million a year to cover personal property taxes on military-owned inventories.

Government lawyers are now working on local and state suits levied on defense contractors: Martin Co., Cal Tech's Jet Propulsion Laboratories, Convair, Aerojet-General, ACF Industries, and others.

Martin has a typical case. Maryland clamped a new state tax on federal contractors. Then Martin –with the Justice Department backing–fought the case and won. Maryland is appealing the matter.

The Government lawyers want a clear cut ruling in their favor to stem the tide of other suits sure to arise. They base their arguments on the concept of "beneficial use"–that is, whether the contractor-used, Government-owned property is being employed to benefit the private company or the Government.

As the federal lawyers see it, the Supreme Court's decision implied that in cases where the sole beneficial use can be proven to be the Government's, the property will be immune from local taxation.

A small Navy satellite . . .

is scheduled to be launched from an inflight aircraft. It is a tightly guarded secret, with Navy officially refusing to acknowledge such a project exists.

It is known, however, that Navy's program on "very lightweight" air-launched satellites is being conducted at its Test Station, and initial launching attempts have failed. This will become top news once one of the small balls are put into orbit.

On its other satellite program–Vanguard–Navy is not doing well. Last launch attempt was made almost two months ago–June 26–and reports are that Navy decided after the last failure to go back over the complete Vanguard system in an attempt to find out what is causing all of the dud shots. All failures to date have come in the first-stage rocket. Part of the Vanguard troubles come from the launch stand, Navy thinks. And it has built a new one. Vanguard's 2nd stage will be used in the A.F. moon shot.

The sea water to fresh water . . .

research program–a six-year-old governmet project scheduled for a big expansion by the House Government Operations Committee. The Committee, reporting after a year-long study, said none of the processes under study can produce quantities of fresh water at costs competitive with natural sources.

The Committee warned that "the Russians are expecting tremendous efforts" in basic research on saline water problems, and might be ahead of the free world in developing new conversion processes.

Congress is currently considering a bill that calls for construction of $10-million worth of saline water pilot plants to test various processing meththods. The Office of Saline Water is handling the project.

Federal $1,000-scholarships, loans . . .

and fellowship grants to worthy students now seems assured. Under the program, state commissions on scholarships would have the authority to pick students under standards laid down in the proposed law. The legislation's purpose is to further the study of science, math and foreign languages; but the state agency will have wide latitude in deciding which kinds of students are to get scholarships–whether they be engineers, liberal-arts students, chemists, education majors, or what.

The program is considerably scaled-down from opening Congress proposals. But it stands a far better chance of winning approval than other federal-aid plans that have been proposed.

PRODUCT-DESIGN MEMOS FROM DUREZ

Insulative molding compounds | **Corrosion-resistant polyester** **Low-cost control knobs**

Official U. S. Navy photo

But what if it rains?

From time immemorial, weather has upset the military plans of men. In colonial days, wet gunpowder could lose a skirmish. Today, one moisture-affected part can nullify months of costly labor on a new missile.

This helps to explain the increasing pressure on moisture-resistant insulations for electronic parts that must not fail. It explains, too, the growing interest in a relatively new Durez molding material, *diallyl phthalate*.

This is the *only* plastic that retains its high insulation values over extended periods at relative humidities above 90%.

Its arc resistance, as measured by ASTM D495 (Method A or B), can be consistently reproduced.

It does not corrode metal contact points.

Because it is a thermosetting material, it provides virtual freedom from cold flow and creep.

You can get this material from us as an orlon-filled granular blue or green molding compound with plasticity values of 10, 12, or 16 by ASTM D731. It is designed to meet the requirements of Mil-M-18794, Type SDI-5.

For a data sheet detailing properties of the compound, and of molded material, check the coupon.

Hetron® ducts outlast metal

Perhaps you've been thinking of Hetron mainly as a *fire-retardant* polyester material.

It's true you get outstanding fire retardance with Hetron. But don't overlook its *corrosion resistance*, which is equally impressive in equipment such as this glass-reinforced ductwork manufactured by duVerre, Inc.

Venting corrosive fumes from a chemical reactor, aluminum ducts failed in 11 months. Ducts made of Hetron 92 replaced them—and have gone 17 months without a sign of deterioration.

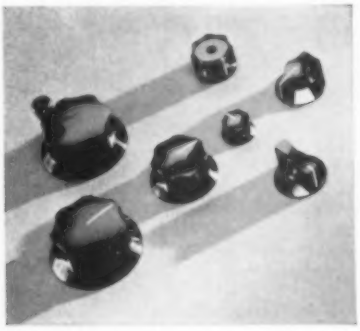
In another plant, Hetron 92 replaces rubber-lined steel ductwork which lasted

duVerre, Inc.

less than a year under the corrosive bite of wet chlorine. The Hetron ductwork, in service four years, has required no maintenance and is as sound as the day it was installed.

Because it is self-extinguishing, you can safely specify Hetron in many places where a conventional polyester won't do. Fire retardance is *inherent*—does not depend on additives that might dilute corrosion resistance.

Are you taking full advantage of Hetron's unique qualities? A check mark on the coupon will bring you an illustrated bulletin outlining properties and uses of the versatile Hetron resin family.



Ready-tooled knobs

Why tool up for a standard item like a control knob, when you can buy general-purpose knobs like these—probably at a good saving?

Many custom molders can supply knobs in Durez phenolic, from stock tooling, to fit most standard mountings. You can have them hot-stamped with numbers or characters; equipped with special motifs.

Styled as a family, they blend smoothly with modern equipment lines; wipe clean without dulling; and stand up to heat, dampness, and corrosive atmospheres. For further information, consult your molder.

For more information on Durez materials mentioned above, check here:

- ☐ Diallyl phthalate, Durez 16694
- ☐ Hetron polyester resins (bulletin)

Clip and mail to us with your name, title, company address. *(When requesting samples, please use business letterhead.)*

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World-wide ...

DEVELOPMENTS TO WATCH...

New family of resins . . .

. . . is stirring world-wide interest. The polycarbonates, first produced by Bayer in Germany and now by GE in the US, are next to be made in Japan. There may soon be a new US supplier, too.

Primary advantages of the polycarbonates, according to these companies, are toughness (impact strength several times that of nylon), heat resistance (400 to 600 F), and useful electrical properties (high volume resistivity and low power factor).

The Japanese company, a subsidiary of Teikoku Rayon, Kyobashi, Chuokuo, Tokyo, says it is already in pilot production of polycarbonate fibers, expects to be producing a ton of resin a day by the end of the year.

The second US company, Mobay, isn't ready for commercial production yet. But Mobay, which already has ties with Bayer, plans to import sufficient quantities of the material for market evaluation, plans to decide within the next 12 months on a commercial plant.

A fiber from Japan . . .

. . . that's said to be as strong as nylon and to offer "outstanding resistance to chemicals, solvents, sunlight and fungus," is headed for US production. It's *vinylon*, produced from polyvinyl alcohol.

Air Reduction has licensed the vinylon production process from its developer, Kurashiki Rayon; is building a multimillion-dollar plant to produce the base resin, and is negotiating with several companies to license the fiber process. (Contrary to published reports, Airco says it does not now plan to produce the fiber—only the alcohol which is its starting point.)

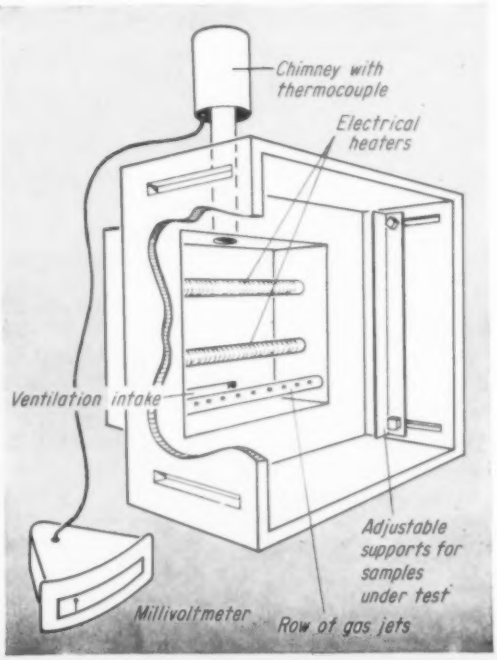
Materials data galore . . .

. . . will be coming from the Second International Conference on the Peaceful Uses of Atomic Energy, in Geneva, Switzerland, starting Sept. 1. More than 2500 papers have been submitted, and a goodly number deal with materials—a surprising percentage coming around the Iron Curtain. Besides the promised paper on magnesium-beryllium alloys from the USSR (*PE—July 7, p 18*), there will be contributions from the USSR on polyethylene; from Romania on bismuth; and from Yugoslavia on zirconium.

Improved flame resistance for fiberboard . . .

. . . is promised by a new impregnation process developed by Hickson's of Castleford, Yorkshire, England, and now being licensed throughout the world. The impregnating compound is not new. It's a water emulsion similar to those previously used on wood. The novelty is the method which, Hickson claims, produces a material having fire-resistant properties that "come close to those of noncombustible materials like asbestos" and also provide protection from fungal decay and termite attack.

To test treated board, Hickson's engineers have also devised a new testing setup, diagrammed here. It is designed for continuous monitoring of the heat generated, as well as observing and timing spread of the flame. Treated board can be compared with untreated or with standard samples by inserting first one, then the other.



To test flammability of fiberboard, Hickson's uses **this** setup. Note thermocouple in chimney connected to millivoltmeter diagrammed at lower left.

Take a New Look at

TITANIUM

Wonder metal? Restricted supply? Not today. Titanium is daily *proving* its economic advantages in more and more industrial applications.

And Mallory-Sharon... world's largest integrated producer of special metals... is ready *now* to assist you in designing with titanium. We can supply your requirements for titanium and titanium alloy sheet, strip, rod, bar, plate and other mill products... many of them from stock.

Check below for ways titanium and its alloys can serve you now! Then write us about your requirements, or contact our nearest sales office.

For availability – *Delivery time on titanium has been cut by Mallory-Sharon's ingot inventory in certain grades and analyses. Here, orders can be started in the ingot stage, saving time for fabricators. In addition, a wide range of sheet and bar sizes can be shipped direct from stock.*

For corrosion resistance– *Turbine impeller made from titanium has given four years' service in highly corrosive application that killed other metals in weeks or even hours. Impeller agitates slurry containing cobalt, nickel, copper arsenic, iron and sulfuric acid.*

For high strength-to-weight – *In the U.S. Air Force's B-58 Hustler, built by Convair, Fort Worth, heat-treated titanium alloy was substituted for alloy steel—for wing fittings bearing heavy loads. Result: 44% saving in weight, with strength equal or superior to the previous material.*

For technical facts *write for "Titanium Fact File"—giving advantages, metallurgy, corrosion properties, information on machining, welding, forming. Our Service Engineering group is ready to assist you.*

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Integrated producer of Titanium • Zirconium • Special Metals

What's happening in SCIENCE

Heavy water available now

You can now buy a cup of heavy water—or anything up to about 50 gal.—without any special license or authorization. The price is reasonable, too: less than $5 a cupful. Reason: the material is now in oversupply, and the AEC is anxious to encourage its use.

Small quantities like cupfuls must be obtained from commercial suppliers, but the AEC is selling the material in 125- and 150-gal. drums at a price of $28 a lb plus a shipping container charge ($43 for the smaller; $100 for the larger).

Heavy water, containing deuterium (the heavy but not radioactive isotope of hydrogen), weighs 9.25 lb/gal. (as compared with normal water's 8.3), freezes at slightly lower temperature, boils at slightly higher temperature, and has an electrical conductivity of 15.0 micromhos/cm. Major use is, of course, in atomic-energy work; but it can serve in tracer studies and should prove a valuable research tool.

Purchasing information may be obtained from the AEC Savannah River Operations Office, PO Box A, Aiken, S. C.

The molecule stages a comeback

After the atom was split, anything as large as a molecule seemed far too gross to rate intense scientific concentration. Molecules looked like kid stuff. But today, in everything from space flight to plastics research, the molecule is emerging as a major operating as well as research tool. Discussions of "molecular engineering" are beginning to appear on meeting programs. Molecular institutes are being set up at universities.

Why the sudden interest? To a large extent it stems from a new approach to the molecule that treats it as an electrical rather than a mechanical or chemical entity. Theories of molecular arrangement on the basis of energy bands are helping to explain semiconductors and their application in transistors, electroluminescent lighting, and solar energy.

It is postulated that the orbital or outer electrons of a molecule can exist at any one of several levels. If the molecule is excited by some outside source of energy, these electrons can be made to jump to a higher level, then give off energy themselves as they fall back to their original place. Furthermore, it is believed that the case with which the electrons of a particular molecule can jump from one level to another determines whether it will be an electrical conductor, semiconductor, or insulator.

Masers, the microwave amplifiers and "atomic clocks" (*PE—Jan 13, p 10*) are molecular devices, developed and explained on the basis of energy-level changes. Electroluminescence, the promising new area light source for instrument dials and information display (*PE—Aug 18, p 17*) is also based on this phenomenon. (For a full discussion of this new development, see coming Sept 15 issue.)

Ion propulsion and free radicals, two of the most promising systems for future space flights, take advantage of molecular rather than atomic fragments, though in this case the molecule is that of one element rather than a compound of several elements.

Furthermore, molecular dissociation at high altitudes may provide a source of energy for future space flights. Under the influence of the sun's radiation, for instance, molecules of nitrogen, oxygen and other elements are broken down into individual atoms, storing up a source of energy that may approach 4,000 megacalories of heat per kg that can be released as the atoms recombine.

As to plastics, the improved properties of the new isostactic polymers (*PE—Aug 11, p 12*) are based entirely on molecular arrangement rather than any change in the individual atoms themselves—or in chemical composition.

It's not that anyone is writing off the value of atomic particles or playing down subatomic research; but, as so often happens, the "old" ways and the old ideas turn out to have just as much value as the new. —ARG

Shooting for better fibers

What happens when a stream of liquid is suspended in space?

That's not an academic question. The answer is an important key to development of metal, glass, and plastic fibers with greater strength, flex resistance, and other desirable properties.

One approach is the apparatus pictured here, developed at Johns Hopkins' Dept of Chemical Engineering. It's a glass cylinder through which a high-speed stream of viscous liquid can be propelled; and, at the same time, vibrated to produce sinusoidal curves and nodes. These, JH scientists note, are directly related to the properties of the material under study. In some, nodes are closely spaced; in others, far apart; and the pattern seems to be quite characteristic.

Liquid "fiber" is propelled through long glass tube from flexible steel nozzle, vibrated at high speed by electromagnet. Stroboscopic photoflash records wave pattern. Setup helps Johns Hopkins researchers uncover fiber structure.

What's happening in MATERIALS

Choosing materials for the Big Freeze

The increasing use of temperatures below minus 250 F, in product applications as well as research (*PE*—Dec 2, '57, p 12, and Oct 7, '57, p 12) is posing new materials-selection problems. While some materials get stronger, many others—even metals—become hard and brittle.

Surprisingly, though, a good many of the common materials serve—and serve well—for handling liquid oxygen (−297 F), nitrogen (−320 F), and even liquid helium (−453 F).

Engineers at Aerojet-General find, for instance, that turbine-driven pumps of conventional design can handle liquid oxygen if they are derated to electric-motor speed. Housings and impellers for pumps like the one pictured, made of aluminum and stainless steel, easily meet ASME specifications.

Sealing is a different matter, though; there is danger of an explosion if liquid oxygen comes in contact with most hydrocarbons, including those which must be used as lubricants. That means special sealing systems and special sealing materials are needed. The Aerojet pump has a fluorocarbon primary seal, a large drain cavity, and a secondary seal.

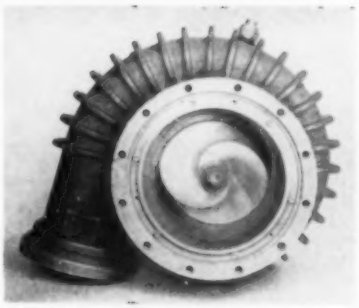
Exotic metals in stock

The "rare" high-purity metals are becoming almost commonplace today.

Pure, ductile vanadium, for instance, a laboratory curio until a few years ago (*PE*—Mar 17, p 66) is now obtainable on a regular commercial basis from several sources. Latest to offer a variety of sizes and shapes from stock is Vanadium Corp of America, which is marketing 99.5% vanadium in "buttons" to 25 lb; cylindrical ingots to 3 lb; and powders from 8 mesh down. Prices are encouragingly modest, too: $40 a lb in quantities of 250 lb or more.

At the same time, National Research Corp says it has a process that will turn out tantalum powder "of a purity hitherto unavailable commercially" on a large scale; and plans to offer a complete line of mill products.

Pure columbium, already available in ingot, rod and sheet, is now being offered in strip to 0.0005 in., with a tolerance to 0.0001. In this case American Silver is the supplier.



For ultralow-temperature service, biggest design problems lie in sealing and lubrication rather than shape or structure, says Aerojet-General. This liquid-oxygen pump has aluminum housing and impeller, but required special sealing materials.

Our own glossary

IV–New Fibers

Call them "acrylic fibers," "dinitriles" or "acrylic alloys," there's a growing family of synthetic materials that is well worth knowing.

They differ in several respects—strength, heat resistance, dyeability. Some are bulkier fibers than others—offering a convuluted instead of smooth fiber surface. Some have better resistance to ultra-violet light. One is noted for its wicking ability; another for its performance under fire.

But all are made from acrylonitrile, and all offer resistance to chemicals and moisture, washability and crease resistance, and many of the other properties that have come to characterize the new synthetics.

Here's a rundown on trade names and producers:

Acrilan: Chemstrand
Creslan: American Cyanamid
Darvan: B F Goodrich Chemical
Dynel: Union Carbide
Orlon: E I DuPont
Verel: Tennessee Eastman
Zefran: Dow Chemical

(Note: For earlier installments of our continuing glossary of new materials, see *PE*—Apr 21, p 17; May 5, p 16, and Aug 11, p 12.)

briefs . . .

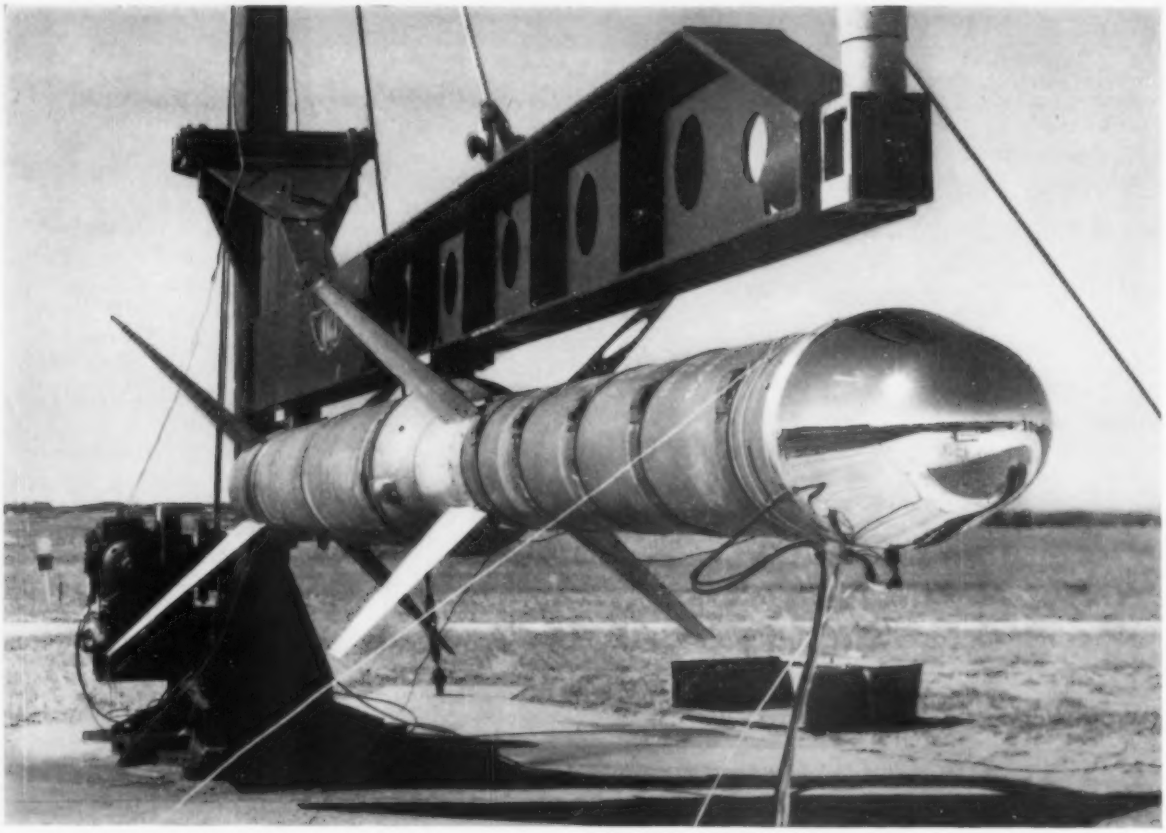
Zirconium's corrosion resistance is slated for major attention by Bureau of Mines researchers at Albany, Ore., in the coming fiscal year. Refining and fabrication methods will also be studied. But the emphasis on corrosion resistance points up the route through which this "new" metal is most likely to gain acceptance by industry. (For data on its properties as compared with other "new" and "exotic" metals, including those mentioned at left, see *PE*—Mar 17, p 66.)

Plastisol coatings can replace leather as chafing covers for wire cable, Navy's Bureau of Ships reports. While the application in this case is a special one—lifelines—the savings are impressive (a plastisol coating, the Navy says, costs about 90¢; leather, $9), and recommends this coating for consideration in other applications where abrasion is a problem.

Vinyl film can be extruded in widths to 52 in. and thicknesses to 130 mils, says B. F. Goodrich Chemical Co., and the material can be held to a tolerance of plus or minus 4 mils. A new flat-type extrusion die is the key, and Goodrich says it should make material available for such parts as refrigerator door linings "at a fraction of the cost of those previously available."

More copper, and new raw materials suitable for blowing to mineral wool or for use in molten-glass products can be obtained from reverberatory-smelter slags, the Bureau of Mines reports. It's inaugurating a study to determine commercial feasibility, also plans to investigate new methods for obtaining higher-purity copper from domestic sources. This is another phase of a major metallurgical research program, of which the zirconium study mentioned above is also a part.

—ARG



EXPERIMENTAL MISSILE is used by NACA researchers to study high temperatures at speeds up to Mach 5. The nose cone is spun Inconel alloy, polished down to a 2 micro-inch finish at the tip. *Photo courtesy of Aviation Week.*

The search to keep a missile's nose from becoming its "Achilles' heel"

Intercontinental ballistic missiles are designed to plunge back into the earth's dense atmosphere at speeds in the neighborhood of Mach 10.

Temperatures in the thin boundary layer of air surrounding it are measured in *thousands of degrees Fahrenheit.*

How do you keep the nose from melting?

A sharp, needle-point nose reduces aerodynamic drag. But it doesn't help dissipate heat. A blunt nose shape does considerably better, even though it causes a high pressure drag, and creates intense heat in the shock wave. One explanation for the good showing of the blunt shape is that heat follows the wave—and just sort of "slides off" the nose.

For experimental purposes, scientists need a nose material that can be spun into a great variety of shapes . . . one that maintains structural integrity far up the temperature scale. And those are among the reasons they often select high-strength, heat-resisting Inconel* nickel-chromium alloy . . .

The National Advisory Committee for Aeronautics, for example, began using Inconel alloy for tests after a several-year-long investigation of materials suitable for use at high Mach numbers and high temperatures.

Of course, much is still to be learned about the mechanics of aerodynamic heating and its applications to the design of hypervelocity aircraft and missiles. But the tests are indicating how the problems can be solved. And advances such as those being made daily by NACA's research are rapidly leading to perfection of "The Ultimate Weapon," the device that may well prevent war among men.

Do you have a metal problem? One that involves high temperatures . . . low temperatures . . . corrosion . . . stress . . . fatigue or some other troublesome factor? Inconel alloy or another of the many Inco Nickel Alloys may be just the metal you've been searching for. Our new booklet, "A Review of Nickel-Base Alloys for Aeronautical Applications," is yours for the asking. *Registered trademark

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Product Engineering **HORIZONS**

August 25, 1958

what's BLACK MAGIC?

More and more frequently, we hear of ideas that sound like sorcery—anti-gravity, anti-matter, space ships, UFO's, extra-sensory perception, to name a few. Propounders of such ideas are imagined as goateed and owl-eyed practitioners of black magic in gloomy caverns, or dismissed with a frightened snicker as crackpots. Too often, they're made the villains of a plot to overthrow humanity. Sometimes, unfortunately, they are.

What happened to yesteryear's black magicians and sorcerers was simple. They died at the stake, by ducking stool, with stakes through their hearts or in some other ghoulish fashion—because they were too far ahead of their fellow men. Basically, man is herd-bound; he wants to run safely with the pack. So any man who runs alone is automatically and obviously either mad or dangerous —or both.

As we have grown more educated, the frequency of charges of black magic has been reduced; now we just brand a man demented and ostracize him. Some are demented; some are merely overly far ahead of their time. But who is to judge? Yesterday's madman is today's decorated and kudoed scientist.

The essential point is that "black magic" may be just an idea conceived too soon. It holds tremendous potential—and danger—for the first man who sees its practical possibilities, for the first man willing to lift his head above the herd.

In theory, at least, the engineer is the man who converts science to practicality. But his environment and his responsibilities tend to convert him to a "no" man—the staff member whose responsibility it is to find out why the new idea won't work. He seeks constantly for reasons why not—and may thus be thrown back into the herd, even to become the leader of the opposition.

This is a grave danger, because it is only the engineer who has the technical background to realize the potentials in a new idea. He must thus be dual in his thinking—seeking for the flaws on the one hand, seeking for the breakthrough on the other. The problem was expressed by C. L. Montesquieu in his *Persian Letters* 237 years ago: "All scientific men were formerly accused of practicing magic. And no wonder, for each said to himself: 'I have carried human intelligence as far as it will go, and yet So-and-So has gone further than I. Ergo, he has taken to sorcery.'"

K. S. Tangerman

Hypersonic Gas Gun Tests Two Ways

SAN DIEGO, CALIF.—Speeds to 13,500 mph, to simulate entry conditions encountered by future missiles and manned space vehicles, will be possible with this hypersonic gas gun, soon to be built by Convair, Div of General Dynamics Corp. The company expects it to be in operation by 1960 at its R & D center here.

In an interview with Product Engineering, Raymond C. Sebold, vice-pres of Engineering, outlined the gun's function: "Missile, nose cone, wing and other models will be tested two ways: firing the model through a 60-ft long, 2-in-dia gun barrel into test chambers at velocities to 20,000 fps; shooting a slug of high-pressure, high-temperature gas past a model."

In the first type of test, when a model leaves the gun barrel it enters a receiving tank 8 ft in diameter by 50 ft long. Here it passes through 4 or 5 baffles intended to stall the driving gases. Then it passes through a necked section 4 in. in dia into the second tank, 500 ft long, the actual test chamber. This may be evacuated to pressures equal to those at 100,000 ft altitude or higher. The tank is fitted with cameras at 20 stations along its length so that schlieren photographs can be taken by collimated spark light triggered when the model passes electromagnetic beams. In addition, Doppler radar for measuring drag, an infrared spectrophotometer for heat radiation, and radio equipment will be used to track and measure model flight. Models fired are limited to the 2-in. dia of the barrel and can be given a pitch in the sabot to check vertical, horizontal and rotational effects.

Alternatively, slugs of air, helium or argon may be fired past a stationary model of up to 6- or 8-in. spread, suspended by threads in the first tank. A thin diaphragm covers the end of the gun barrel until both breech chambers have been fired. Scribed with a pair of crossed lines, all three diaphragms break at the center and bend back out of the way of the passing gases. Gases pass the model in 1 millisec when air is used. This represents 70-100 model lengths of flow—ample to determine atmosphere-entry characteristics.

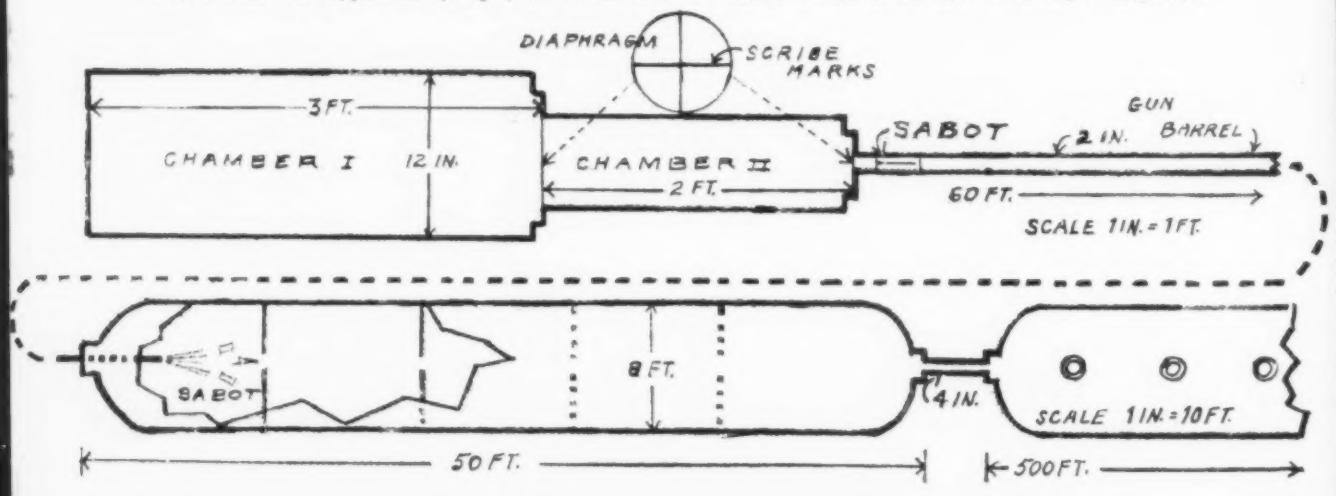
Air is the most interesting test gas because of its close duplication of actual missile flight. Complex molecular dissociation and ionization, at the impact of model and high-speed gas, strongly influence radar reception. Argon, a stable, monatomic gas, simplifies mathematical analysis of model characteristics, while lightweight helium permits the achievement of very high Mach numbers though the test results require extensive interpretation to be applicable to air.

Main advantage of the system, says Charles W. Frick, chief of applied research for Convair—San Diego, is that heat balance between air and missile closely parallels that of actual flight. The conventional hypersonic wind tunnel chills the air as it expands. For example, a more conventional tunnel, in operation at the GE Research Laboratory in Schenectady, can achieve speeds to Mach 28. Highly compressed helium flows through a nozzle to a test section where near-vacuum is maintained. The very high velocities are accompanied by temperatures as low as 2 or 3° above absolute zero. Similar nozzling permits tests to Mach 30 with the Convair gun.

The new installation offers extreme versatility, combined with much lower equipment costs. The big problem is one of instrumentation. For example, model temperatures will be telemetered to a receiver near the flight path by a tiny electromagnetic transmitter built into the model. But the models can be used only once.

The gun is being designed in consultation with Dr. Zaka I. Slawsky of the Naval Ordnance Lab at Silver Springs, Md, where a similar gun is already in operation.

Complex combination of cylinders . . .
the firing chamber of the hypersonic gun consists of a base cylinder 12 to 15 in. in dia. by 3 ft. long joined to a smaller one 7 in. in dia. by 2 ft. long, joined in turn to a 60-ft. x 2-in. ID barrel. The smaller breech cylinder has stainless-steel cross-scribed metal diaphragms at each end. Each chamber is filled with a stoichiometric (balanced for complete combustion) mixture of oxygen and hydrogen, with helium as a vehicle, compressed to 10 atmospheres. The smaller chamber is fired first by a hot-wire (110-volt) circuit. This raises pressure to about 8000 psi. Then the larger chamber is fired. The high-pressure helium ruptures the stainless-steel diaphragm separating the two chambers, and a shock wave moves through the smaller chamber to rupture diaphram separating "breech" from gun barrel. At 100,000 psi and 7500 to 12,000°R it speeds the sabot or air slug to 20,000 fps.



New-born NASA Piles Up Space Projects Totalling $343 Million

Dr. T. Keith Glennan

WASHINGTON—The new National Aeronautics and Space Administration (NASA) is beginning to spark. The President has appointed T. Keith Glennan, president of Case Institute, Cleveland, as director of the agency and Dr. Hugh L. Dryden as deputy director. Dr. Dryden directed the National Advisory Committee for Aeronautics (NACA) that now is supersede by NASA.

Officially, the new agency was born July 29, when the President signed the measure creating it. It has 90 days, however, to take over the functions of the former NACA and the additional job of handling nonmilitary space projects.

Much of the groundwork to put NASA into action is already done. Space projects it will work on have been drawn up, along with its first year's budget (see table next page). NASA wants $343 million for the first year's work, including its continuation of the NACA functions. Next year, it is estimated the budget will more than double. Within two to three years NASA is expected to be spending over $1 billion a year.

The Administration has asked Congress to vote $125 million in new money for the agency; $117 million is slated to be transferred from the Department of Defense; and Congress had already voted $101 million for NACA functions.

During first year's operation, NASA plans to spend some $187.2 million on research and development, with around $75.8 million of this slated for private-industry contracts.

In addition, the agency will spend $28.2 million on new construction to expand its facilities and $19.5 million for new equipment and instrumentation. It is also asking Congress for $7 million to cover salaries and expenses for some 800 new employes—over 700 of them to be engineers, scientists and technicians—to add to the 8200 already employed by NACA.

ANOTHER CAPE CANAVERAL

Biggest chunk of construction and equipment funds will go to expand NACA's facilities at Wallops Island, Va. This will include a variety of additional control and tracking systems.

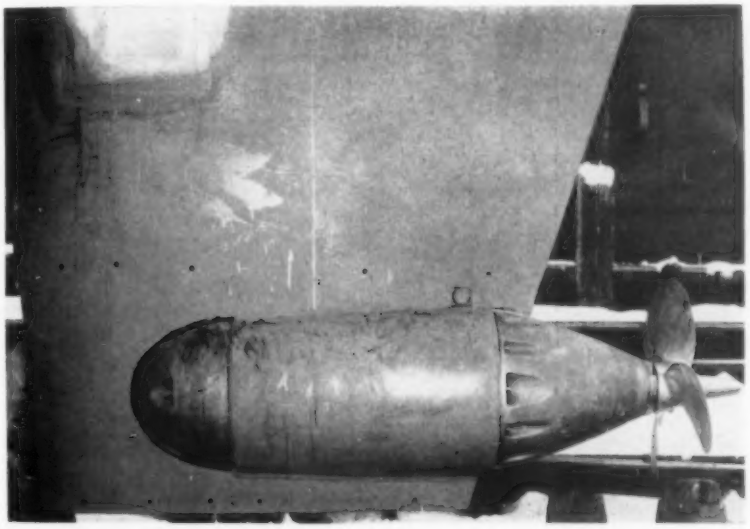
In effect, NASA is converting the Wallops Island facility to perform much the same work performed for the military's missiles program at Cape Canaveral, Fla. The latter site, NASA says, is already too overloaded to take on the additional space projects. In addition, NASA will take over the net of minitrack and optical tracking stations set up to monitor IGY satellites. Some $9.5 million will be spent to expand these facilities.

The $19.5 million to be spent on equipment and instrumentation breaks down roughly to $9.5 million for expanding the minitrack system; $4.4 million to install the down-range data-acquisition station; $4 million for the re-entry command-control systems; and $1.5 million for portable launching and instrumentation systems.

A new space projects center will be built on the outskirts of Washington, D. C. at Beltsville, Md. Some $3.7 million will be spent to build the center and pay for its 600-man staff. Present plans are to leave the headquarters offices of the space agency in Washington at the present NACA site, close to the White House.

NASA 4-POINT PROGRAM

For a starter NASA has prepared a "rather firm but not completely finalized" program. This includes virtually all phases of space exploration including unmanned earth satellites,



For underwater use only . . .

This 50-hp polyphase, squirrel-cage, single-speed electric motor comprises one of the actuated rudders on one of our latest submarines. Both coil insulation and bearing materials were selected for salt-water cooling and lubrication—and will not function properly out of water. Other possible applications: submersible well pumps, boiler-feed pumps. Irradiated polyethylene is the winding insulation; bearings are rubber for salt water use, will be graphite for fresh water. Insulation is not good at high temperature, so motor must be derated if it is run elsewhere than in cool water. Although this motor is a special application, others of the type soon will be available—only in the 100-hp to 2000-hp range—from General Electric.

lunar probes, supporting vertical probes or sounding rockets, etc. The agency will handle four major categories: (1) The US IGY satellite program; (2) part of the Department of Defense scientific space flight program; (3) potential satellite-launching vehicles of the near future; (4) scientific experiments proposed by the scientific community.

In the IGY program, the NASA wants to continue much along present lines, that is, learning how to make the satellite itself work—such things as temperature control, telemetering etc; and experiments in data collection relative to conditions in space—cosmic rays, ultraviolet radiation, etc. The IGY program was slated to end around the middle of next year; NASA plans to keep it going.

Such space flight programs now being conducted by the military's Advanced Research Projects Agency, as satellites and lunar probes, will be supported by NASA and eventually many of them taken over completely.

Among the things NASA will push —some already started—is development of an engine with thrust of from 1 million to 1.5 million lb. This is considered basic to future space experiments, but NASA says the project will take 4 to 5 years. NASA expects this engine, when coupled with a second- and third-stage rocket, would put a 40,000-lb weight into a 300-mile circular orbit—or 10,000 lb around the moon and back into the earth's orbit. Other related projects:

Longitudinal axis-spin satellite stabilization; communications satellites; satellites supplying meterological data; solid and liquid high-energy fuels; vehicles to house man in orbital flight.

NASA's R & D Spending Plans for First Year

Project		Estimated Cost ($ million)	
Space Science			64.70
Advanced Research Projects Agency Commitments		13.60	
Army Ballistics Missile Agency lunar probes and 1 satellite	6.10		
3 Air Force Ballistic Missile Div. lunar probes	6.10		
Naval Ordnance Test Station lunar probe instrumentation	0.20		
ABMA 100-ft NASA sphere	4.50		
ARPA scientific payload research	1.00		
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USSR Proposes Vast Automation Scheme

Soviet engineers have made enormous technical strides in a short time and are restless in their drive to apply them throughout industry. Here Peter Trippe, who visited the USSR, analyzes the eye-opening automation program

LONDON—The Soviet Union is launching a massive plan to install electronic computers for controlling production processes in all major industries. The goal is complete integration of automated production. Scope of the plan was outlined by I. I. Kuzmin, chairman of the State Planning Committee, at a recent Moscow conference on Integrated Mechanization and Automation of Production Processes.

Kuzmin called for 1400 new automatic production lines between 1959 and 1965 in the metalworking industry alone. The woodworking industries also are scheduled for 350 new automated lines in the same period.

To build these and other facilities, Kuzmin wants a 10-fold increase in output of industrial control equipment by 1959. He also plans a 5-fold increase in automation equipment, 6-fold increase in industrial instruments for automation, and 15-fold increase in computers by 1965. The program will require designing 2000 new types of control instruments and control devices. All this is part of a larger goal to double or triple output of major industries within 15 years—the

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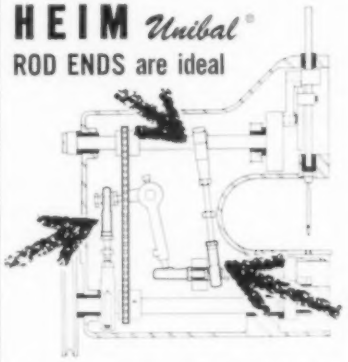

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rate of expansion set by Khrushchev at the Jubilee of the Supreme Soviet.

Khrushchev's year-old decentralization order, the Soviets believe, will help administer plants geared to automation. Production targets, as they see it, will be set by Kuzmin's planning committee, and transmitted to plants through regional economic councils. Each plant will in turn operate at its optimum based on a computer analysis of its best production schedule. Schedules from each plant and all industries, fed back to the big plan, will modify or alter it where necessary. Through such interaction, with independent units producing at optimum rather than for a fixed goal, the Soviets believe they can create a self-correcting production-administration setup.

Before decentralization, production was the responsibility of several powerful ministries, each created to guide a specific industry. Khrushchev eliminated them, saying they failed to give effective guidance to the USSR's 200,000 industrial establishments—even though results under the old plan were spectacular.

The ideas the Soviets are trying to work out obviously draw heavily on concepts of operations research, linear programming and other new ways to organize production. (Recently, Mr. Trippe lunched with a Soviet engineer, closely connected with the decentralization plan, who asked for every possible item of reference material on the theory and application of operations research.)

Automation will be applied systematically through all industry if Kuzmin's proposals are accepted. The Central Planning Committee would monitor both the application and technical development of automatic equipment. The committee will be assisted by a subdivision on automation now in existence and a Council on Automation being set up.

SOME WON'T LIKE IT

Some of the currently privileged institutes will undoubtedly view the plan with little enthusiasm. ENIMS, the machine-tool research institute, may lose some of its unquestioned authority and become merely a basic institute for theoretical research. In that case, ENIMS would take more orders from the Academy of Sciences in the future. Choice of a plant to mastermind technical developments—choice between the Ryazan or Mos-

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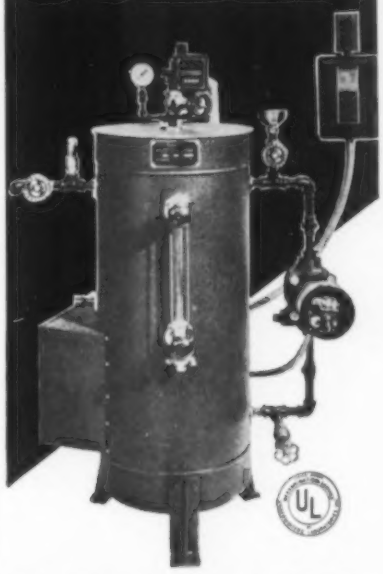

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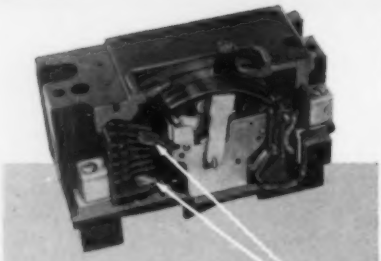

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The new I-T-E "E" frame circuit breaker marks a significant advance in obtaining high ratings for small breakers. The "E" frame design now provides ratings up to 100 amperes at 250 volts a-c, in a more compact breaker than previously required. The resulting space-saving advantage means smaller over-all size of 100-ampere, 250-volt panelboards.

A contributing factor in the success of this development was the adoption of Gibsiloy silver-tungsten electrical contacts.

The use of Gibsiloy contacts helps make possible the efficient performance of the "E" frame. And, Gibson-developed contacts in the "E" frame breaker are small and economical without sacrificing any of the qualities necessary for dependable performance through constant duty.

I-T-E, in the development of the "E" frame breaker—with increased rating, compact design, and economy of operation—drew from Gibson's 23 years' experience and ability to provide the right electrical contact for their new breaker. Call on Gibson to help solve *your* contact problem.

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cow Krasnii Proletarii plants for lathe development, for instance—may cause friction between the two.

Most-advanced techniques are foreshadowed. Says Kuzmin's report: "A technical revolution is ripe today. Vast opportunities are provided by the fundamentally new system of automation. Electronic machines will perform all the necessary computations and will independently conduct technological processes at optimum efficiency."

The capital cost of automated power stations—a major goal of the last 5-year plan—was recovered in 1½ to 3 years. Automatic equipment for producing artificial fibers is expected to pay for itself in 7 to 8 months.

Six million rubles ($1.5 million) were spent to automate 12 blast furnaces. Additional output from the furnaces was said to be equivalent to the output from a traditional $250,000 furnace. In effect this is a saving of 94 million rubles in capital costs. Automatic techniques applied to oil production cut labor costs by 30,000 men and saved ½ billion rubles ($125 million) in capital costs.

MOVE FAST IN AUTOMATION

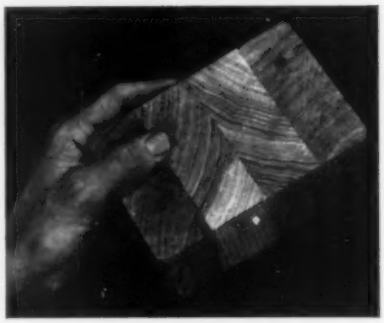
In the USSR, only 18 months ago, there was no evidence of computer or tape-control techniques, numerical control or feedback systems. The only computer in evidence was a primitive model in the Polytechnic museum. Since then, details of computers that are actually in production have become available (*PE—July 14, p 16*). These machines apparently use advanced techniques such as superconductivity for memory circuits and transistorized printed circuitry for portable and transportable elements.

The Russians say they have also completed tests on what they claim is the world's first automated engine driver, capable of carrying out a timetable under completely automatic programming and control. And they claim the world's first feedback system to control a tube-welding plant.

The USSR drive for technical improvement is compulsive. They refuse to be complacent. A typical attitude is that expressed by a chief designer at the automatic ball-bearing plant, who said the plant was obsolete the moment it went into production.

This passionate drive toward a receding target is a basic Russian attitude. It is an attitude of "constructive dissatisfaction" that will permeate the drive toward automated industry.

WHAT'S YOUR
WOOD
PROBLEM?



Gamble research lengthens industrial floor life up to 10 times

THE PROBLEM. Ordinary industrial wood block flooring was proving a costly maintenance headache in plants where certain floor areas — loading docks, aisleways, intersections — were subject to heavy traffic loads. Flooring in these areas was rapidly breaking up.

THE RESULT of Gamble testing and development: a laminated end-grain hickory flooring specially made for these heavy-load "hot spots". Gamble engineered flooring lasts up to 10 times longer when subjected to day-in, day-out punishing loads that would quickly break up an ordinary floor. Chances are, Gamble could help with *your* wood problem.

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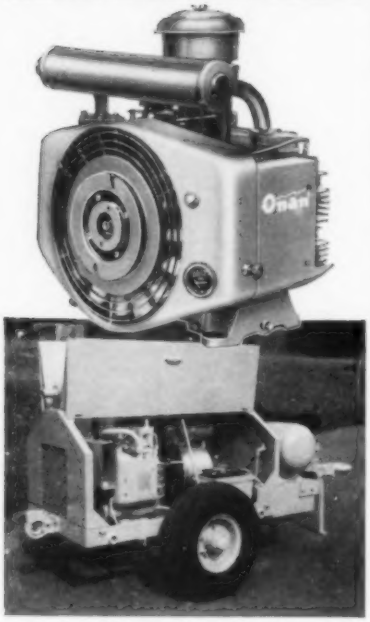


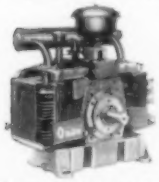
In military service, too...

Onan CCK engines get the tough jobs

This rotary compressor, driven by an Onan CCK engine, is being built in quantity for the Air Force by the Davey Compressor Company. It is rated at 16CFM at 200 PSI and after passing the 1,000-hour continuous operation test, delivered more air per minute than at the start of the test.

The Onan CCK engine combines four major advantages for outstanding performance. It develops 12.9 H.P. yet weighs only 148 pounds. Its alternate-firing, two-cylinder design is compact and free from vibration. Large bearings and rugged construction make it a dependable, long-life power source.

Onan CCK power can step up the performance of *your* equipment.



REAR VIEW showing crankshaft extension.
Overall length including crankshaft is 14¾"; height 21¹³⁄₁₆"; width 18½". Rope starting is standard; recoil or electric starting available.

Onan also builds military gasoline engines; air-cooled Diesel engines, electric plants and generators. Write for information.

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Deplores By-passing Small Firms

Los Angeles—The Government should make more efficient use of small manufacturing plants, H. J. Petersen, executive vice-president of Topp Industries, Inc, recently told the House Select Committee on Small Business.

Petersen made these four recommendations for getting at talent that he believes is often locked inside the small firm:

- A comprehensive listing of small-firm facilities, to guide major contractors.
- Prompt payment for work done by small firms. Many lack working capital and Small Business Administration loans are approved too slowly to cover emergency needs.
- Better channeling of information on Government procurement needs. Small firms cannot afford marketing studies that guide big organizations. They are further inhibited by obsolete security regulations.
- Means for small firms to test prototypes. Rigid quality control and reliability standards for missiles and supersonic aircraft require tests that often run from one to 10 times cost of the hardware. Such expense should be recognized in contracts. Further, the big company gets preference in use of Government test equipment, factory areas and land because facilities are rented at a fixed price that is a great burden to the small firm.

Small companies, Petersen noted, employ excellent engineering talent. These engineers have extensive knowledge of the narrow field that the small firm, by virtue of its size, operates in. Such specialized knowledge should dovetail well with the more general knowledge possessed by engineers in large firms and, Petersen believes, should be put to work.

Wind Tunnel Without Pumps or Fans

Los Angeles—A wind tunnel giving velocities up to Mach 14 and simulating altitudes over 250,000 ft will start blowing for the University of California. Because it has no fans or vacuum pumps (the latter would be inefficient under such operating con-

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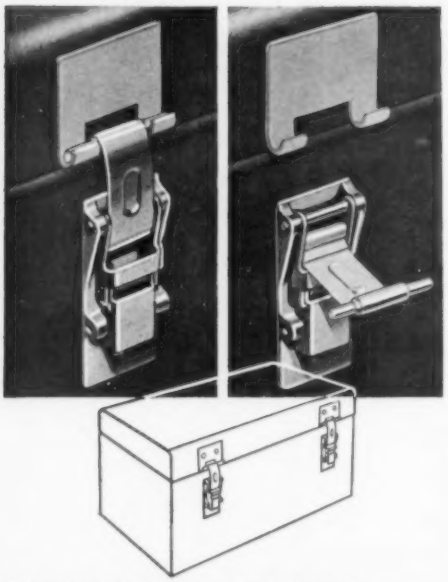

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ditions) the tunnel can operate 10 hours before shutdown for defrosting its condenser.

As described in the publication, SC Engineer, the test apparatus uses an extremely-low-temperature refrigerator and condenser to maintain a pressure differential across the supersonic nozzle. The single-stage helium refrigerator, operating on a reversed Carnot cycle, holds the condenser's temperature at 20 to 30 K and reduces pressure to approximately 10^{-4} mm.

The flow medium is pure nitrogen heated to 450 K by an electric heater in the main tank. As it passes through the supersonic nozzle, the nitrogen converts to a high-velocity low-density flow in the test area. Once past the test section, the gas flows through a heat exchanger that cools it to room temperature and to the condenser. Major power requirement is the 50 hp needed to run the refrigerator. The jet size can be from 5 to 40 in dia.

The test facility will use the nitrogen to simulate both low-altitude slip-flow conditions, where gas molecules behave as a continuous fluid, and high-altitude free flow where they behave independently.

Sort Peas, Beans, Nuts By Color Electronically

AMSTERDAM — The time-consuming job of color sorting by hand such things as peas, beans, groundnuts, coffee beans has been replaced by an electronic machine designed here by M. J. de Goeje of Zaandam, Holland.

The products to be sorted are rapidly conveyed, in front of photo-electric cells which emit impulses that vary according to the color reflected. If the color differs from the stipulated amount, a 1½-2 psi air blast gets rid of the off-color product.

Sorting-machine design is such that the total capacity can be easily adapted to the volume of work. Depending on the product being sorted, the capacity of each sorting unit varies between 33 and 154 lb per hour. The unit is capable of sorting off-color products from correct-color products and can sort different colored products.

DeGoeje says that the accuracy is about 90-95% that of manual sorting in the case of green peas, and that for accurate sorting of this product it is advisable to follow up mechanical pre-sorting by manual sorting.

Bits And Pieces

COLUMBIUM HAS WON 30,000 supporters from the AIME in the columbium-niobium tug of war, so the Institute proclaims. Through compound errors dating back 150 years, the steel-gray metal, now important in reactor technology and jet engines, boasts both names—with supportors for both.

STANDARDIZED TESTS for measuring shear strength of brazed joints are the goal of a new American Welding Society brazing and soldering subcommittee. The subcommittee, headed by Harry Schwarzbart of Armour Research Foundation, was organized after authorities indicated need for standards.

FIRST ARMY PROJECT to use the Air Force weapons-system management concept will feature The Martin Co in the roll of prime contractor to develop the Pershing solid-propellent missile in the 500-mi range. Major subcontractors selected by Martin are: Thiokol Chemical Corp for rocket engine, Bulova Watch for the fuzing and arming system, Thompson Products for the transporter-erector-launcher system, and Bendix Eclipse-Pioneer Div for inertial guidance.

ATOMIC-POWERED PRIME MOVERS for highway trucks and locomotives are under development by a team of Russian scientists and engineers.

THE DIESEL ENGINE has not even come close to exhausting its potential for application to vehicle propulsion, said Peter Kyropoulos of General Motors in discussing the potential for unconventional powerplants for vehicle propulsion at the recent SAE West Coast meeting. He added that the gas turbine shows great promise in the size range beyond the diesel, but that other powerplants (solar, nuclear, electric, free-piston) do not show promise for the foreseeable future.

MORE ALUMINUM PER CAR in the 1959 models is claimed by Kaiser Aluminum & Chemical Sales, Inc. The average amount of aluminum per car in 1959 will be 57.1 lb compared with 50 in 1958 and 46.3 in 1957. Gains are attributed to more use for moldings, trim areas and optional equipment in design.

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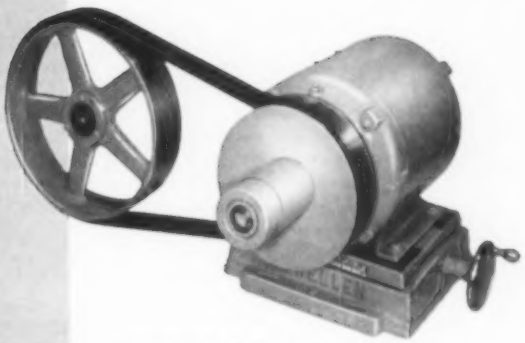
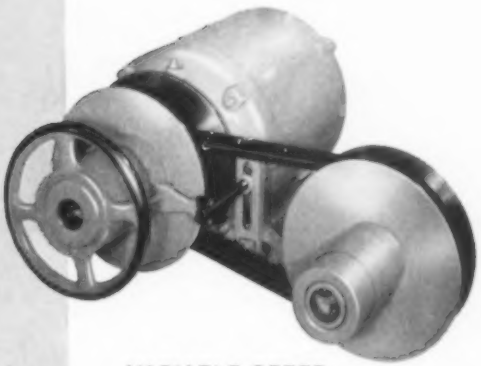
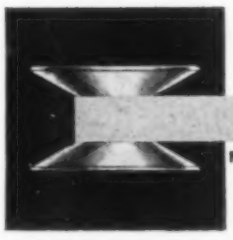


VARIABLE-SPEED PULLEY
Ratings to 15 H.P. Speed Ranges to 4:1



VARIABLE-SPEED COMBINATION PULLEYS
Ratings to 25 H.P. Speed Ranges to 10:1

Here are design changes that greatly enhance the flexibility, usefulness and convenience of Variable-Pulley Drives . . . that make the new Lewellen 400 Series a MUST for you to check and compare.



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DESIGN IT IN 3-D

HENRY J. REINIG

Singmaster & Breyer
New York City

■ There's no doubt the designer sees the same three-dimensional world as other men—the same blocks, cylinders, spheres and cubes. When he gets design ideas, doubtless they're in solid form, too. Then the confusion begins.

For he turns to his drawing board and sets down his ideas in two-dimensional drawings. Even engineers have trouble reading these modern hieroglyphs and many technical men—physicists and chemists—can't even recognize their own ideas on such orthographic drawings. Industry learned that during the war.

But the designer still has to communicate. Now that complex technology has brought the team approach, he must make his ideas clear to other technical men, and management too. And he's discovering that old-style blueprints aren't the answer.

For simplified communication he must first understand his ideas himself. And there's no better way to clarify thinking than to set design ideas in 3-D form.

Axonometrics are clear enough for anyone to understand. And because axonometrics show the over-all approach to design, the designer and other technical men know where they stand too. These 3-D graphics show knowns and unknown; they tell the engineer which dimensions are variables, which are constants. And they allow

3-D . . . THE SOPHISTICATED VIEWPOINT

For thousands of years, only the Chinese drew in 3-D.

Both engineers and artists in ancient Egypt were ignorant of perspective. Egyptian drawings show men only in profile—with eyes in the side of their heads.

The Greeks didn't recognize the subtleties of perspective, either. And Euclid's geometry didn't help them—they had to build the Acropolis without isometrics.

Somewhere in the Middle Ages, Flemish painters began to struggle with perspective; by Leonardo's time, Renaissance painters had mastered it. Ironically, in the 20th century—with cubism—artists learned to ignore it.

3-D engineering drawings go back to Leonardo's sketchbook of his inventions, perhaps further: in the 15th century, artist-mathematicians Ucello and Francesca both worked out geometric proofs for perspective; and Francesca got credit for discovering the vanishing-point concept on which perspective drawing still rests.

Today's engineer can represent his ideas graphically with either models or drawings. Models have helped design everything from pyramids to submarines, and plastic models have been used for stress analysis.

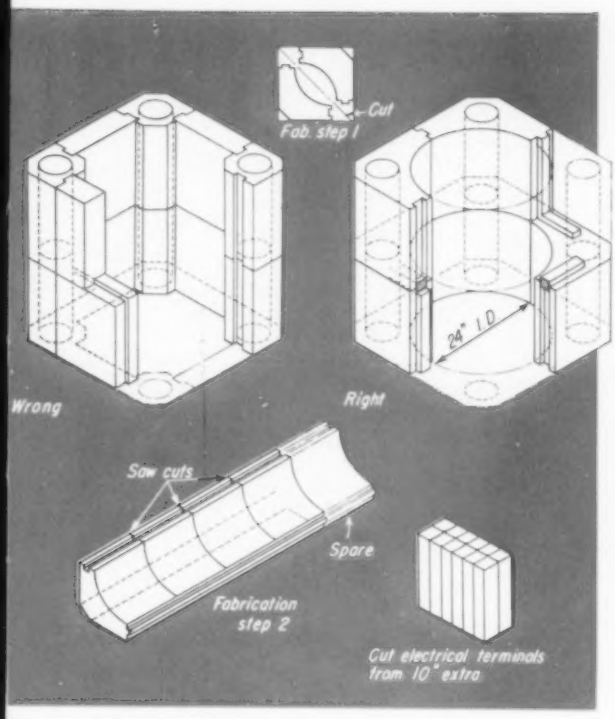
Graphic drawings include not only the familiar orthographic drawings, but also schematics, axonometrics, and perspective drawings:

Schematics are symbolized drawings, such as process, engineering, and kinematic diagrams. They're widely used in R & D.

Perspective drawings approximate the way an object appears to the eye. But they're not scalable, so they don't suit the engineer too well.

Axonometrics are all 3-D drawings. They're scalable, so they are an excellent design tool and come in three types:

- dimetric—the horizontal and one vertical plane are at one angle to the viewer's eye, the other vertical plane is at a different angle.
- trimetric—all three planes are at different angles to the viewer's eye.
- isometric—all three planes are at the same angle.



Ends arguments . . .
over conflicting designs. Crucible on left was proposed by mechanical engineer, one on right by electrical engineer. This isometric drawing showed the ME that the other crucible was easier to build, so he changed his mind.

the design team to come up with an integrated design—which means fewer bugs during plant tool-up and operation.

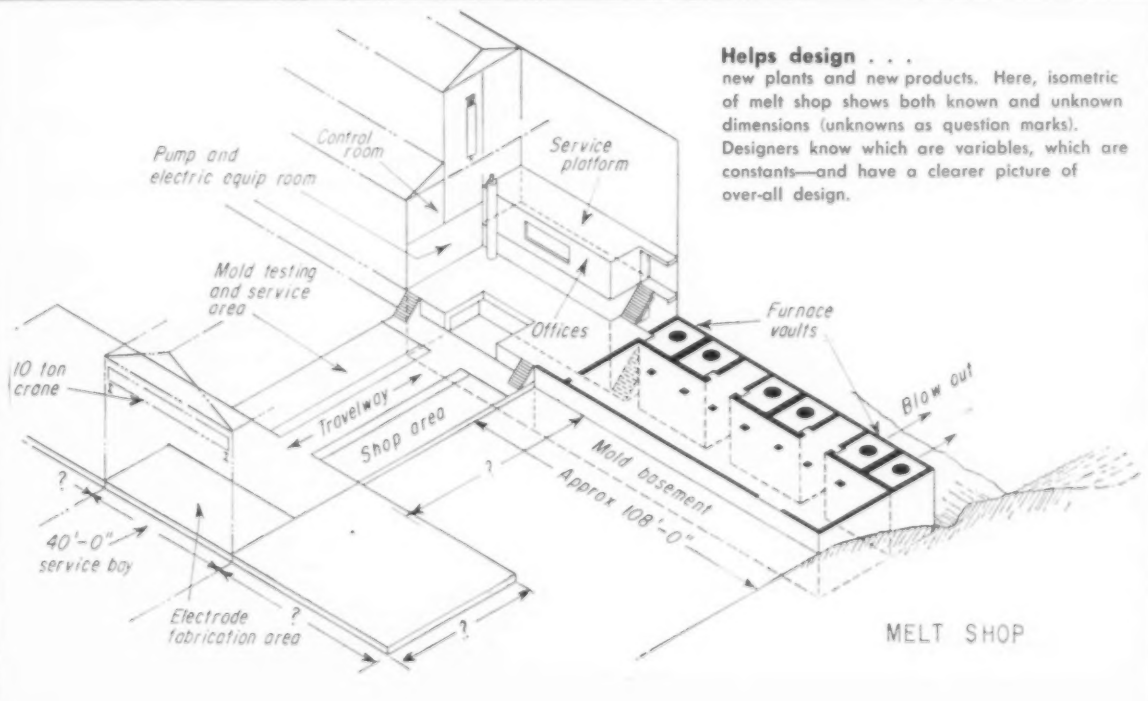
Such drawings show the team just how design work is going: Each day they see just how far they've progressed—and how far they have to go. This helps them to schedule ahead.

The drawings help the team "sell" management, because even a layman can understand isometrics. Note that consulting firms use lots of 3-D—they have to "sell" their design, both to outside management and to outside engineering staffs. And axonometrics make a more effective presentation.

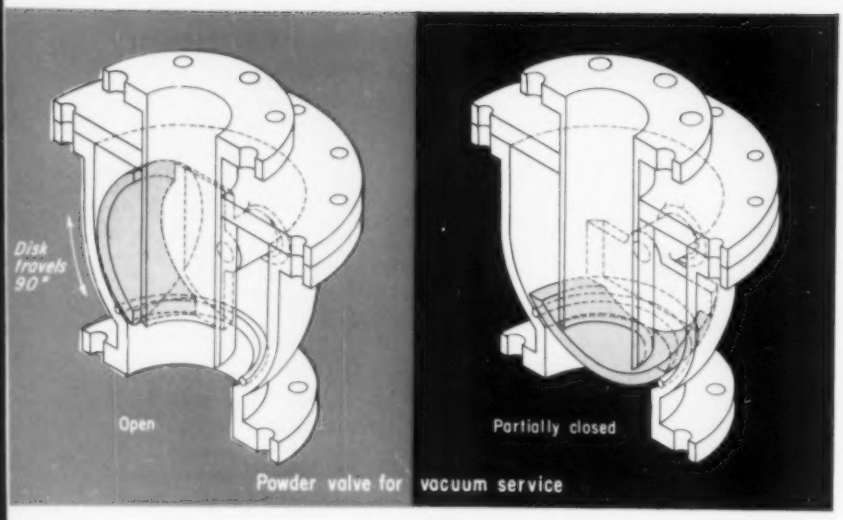
Transposed Timing

Many companies use isometrics now—but in the wrong way. Instead of designing and developing in 3-D, then detailing on blueprints for production, they do just the opposite. They design and develop in two dimensions, then go to extra expense to make isometrics as production aids.

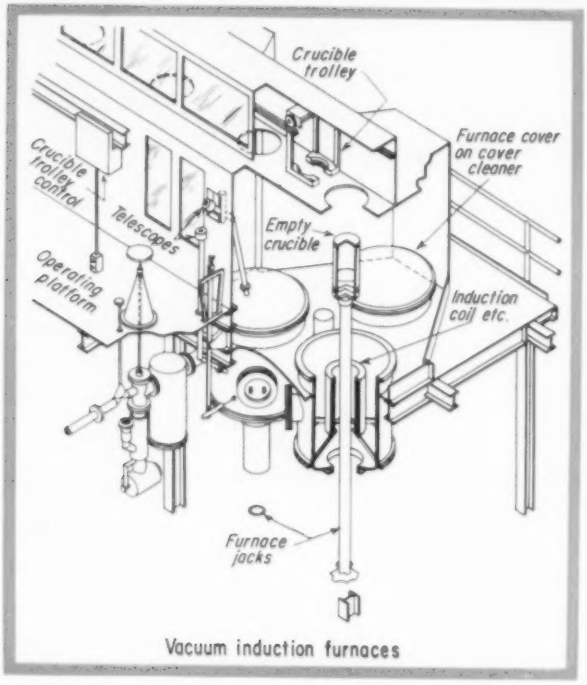
The auto industry, for example, booms the visual-aid use of graphics for design engineering, management orienta-



Helps design . . .
new plants and new products. Here, isometric of melt shop shows both known and unknown dimensions (unknowns as question marks). Designers know which are variables, which are constants—and have a clearer picture of over-all design.



Simplifies production . . . shows valve assembly and function. The same graphics can be used later for sales and service instructions.



Vacuum induction furnaces

Increases sales . . . because axonometrics show management "how it will look" far better than orthographics can. And they help customer's engineers to understand the project.

tion, production, sales, and service. But their axonometrics merely supplement shop drawings.

The aircraft industry is an exception: Lockheed, Douglas, and Martin use axonometrics for design development. So do most consulting engineers, who feel that axonometrics are more readable and save on drafting costs.

Simpler Means Cheaper

The designer holds the key to the cash drawer here. **If he designs in 3-D, the same set of drawings can be used for development, production, sales, and installation.** He'll need orthographic drawings only for production detailing.

Don't be taken in by the claim that 3-D drafting involves complex–and costly–skills. Almost any draftsman can learn to make isometrics; a really good one can teach himself. Just make sure he has the proper ellipse guides and isometric protractors. With them, two construction lines determine a circle; without them, he needs eight.

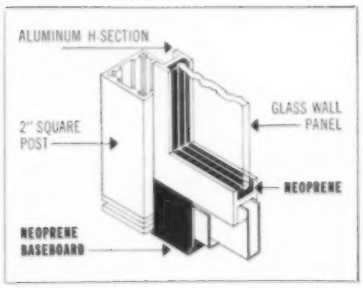
With isometrics, you can simplify drafting still further. Because all planes are at the same angle to the viewer's eyes, a draftsman needs only one scale and one set of ellipse guides.

The training and tools for teaching draftsmen to make isometrics are time and money well spent. They'll pay off in clearer drawings and long-term drafting economy. ■

TRENDS in appearance

U-shaped gasket of Du Pont neoprene remains resilient under compression, resists deformation, and retains its sealing properties despite frequent movement of the panels.

Movable panels cushioned with gaskets of Du Pont neoprene



Section of office partition. Aluminum H-sections, keyed into 2 in. square posts, support the panes. Neoprene gasket seals and cushions the glass. Baseboard is also neoprene.

Two linear miles of office partitions were installed in the new Connecticut General Life Insurance building in Hartford, Connecticut. In designing the movable walls, architects Skidmore, Owings, and Merrill required a resilient cushion for the panes. They chose extruded gaskets of Du Pont neoprene synthetic rubber.

Neoprene is a vulcanized rubber, not a thermoplastic. It does not "cold flow" under pressure, nor relax over the years and lose its grip on the edge of the glass. Neoprene is chemically stable, and is highly resistant to the slow deteriorating process of natural aging. It is outstanding among elastomers for its ability to retain its properties for long durations of time. Neoprene will not crack, harden, or lose its strength and extensibility.

A combination of durable properties makes neoprene an excellent choice for parts and products that must withstand severe conditions. Neoprene is resistant to oil and grease, most chemicals, abrasion and cutting. It performs well over a wide temperature range and will not support combustion. Samples of Du Pont neoprene have withstood 23 years' exposure to sunlight and weather.

For more information on the properties and design possibilities of neoprene and HYPALON®, a new Du Pont synthetic rubber, clip the coupon below.

ELASTOMERS IN ACTION HYPALON® • NEOPRENE

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. . . through Chemistry

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☐ Send me a free copy of *The Du Pont Elastomers* (a review of the properties of neoprene and HYPALON).

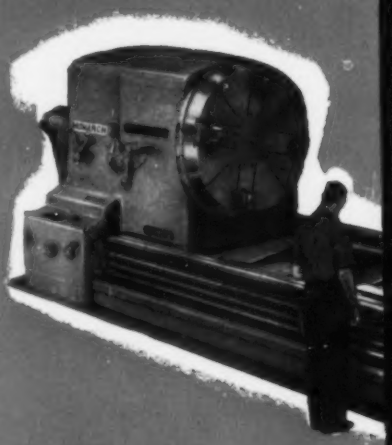
☐ Add my name to the free mailing list of the *Elastomers Notebook* (contains articles based on the uses of Du Pont elastomers in industry).

E. I. du Pont de Nemours & Co. (Inc.)
Elastomer Chemicals Dept. PE-8
Wilmington 98, Delaware

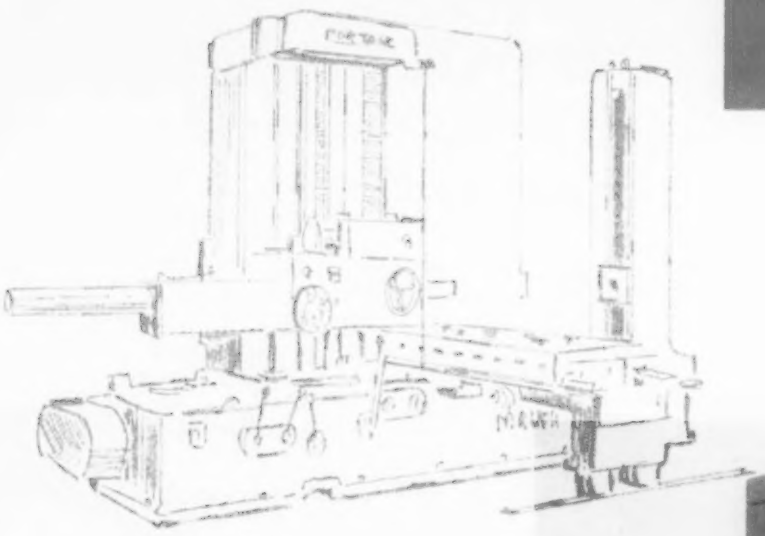
Name _____
Firm _____
Address _____
City _____ State _____

design

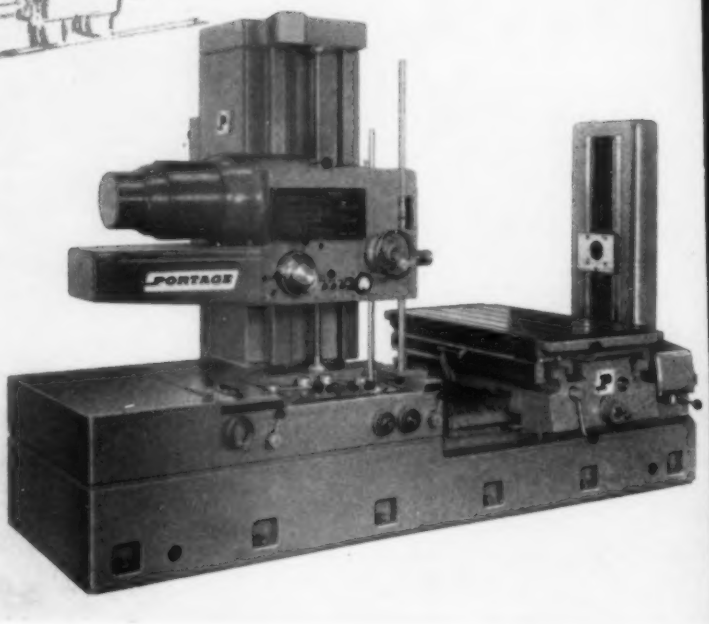
TRENDS in appearance



The great size and characteristic thin-walled structure of such components as nose cones, nozzles, motor cases, air-frame sections, hemispherical and elliptical domes has imposed a new look on some contour lathes. Stock removal is relatively light, so drive motors are less powerful than is usual on these turning-boring-facing machines, which may measure up to 300 in. between centers and have face plates up to 80 in. dia. Such lengthy, wide-ranging tool travel has also resulted in platforms on which operator stands and that moves along with tool carriage. Tracer systems may be semi or fully automatic, of the air-gage type as in Monarch Machine Tool Co lathe (right), or electronic as in unit (sketch) by Lucas Machine Div, New Britain Machine Co.

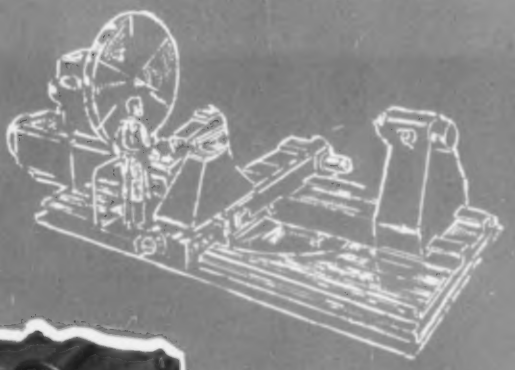


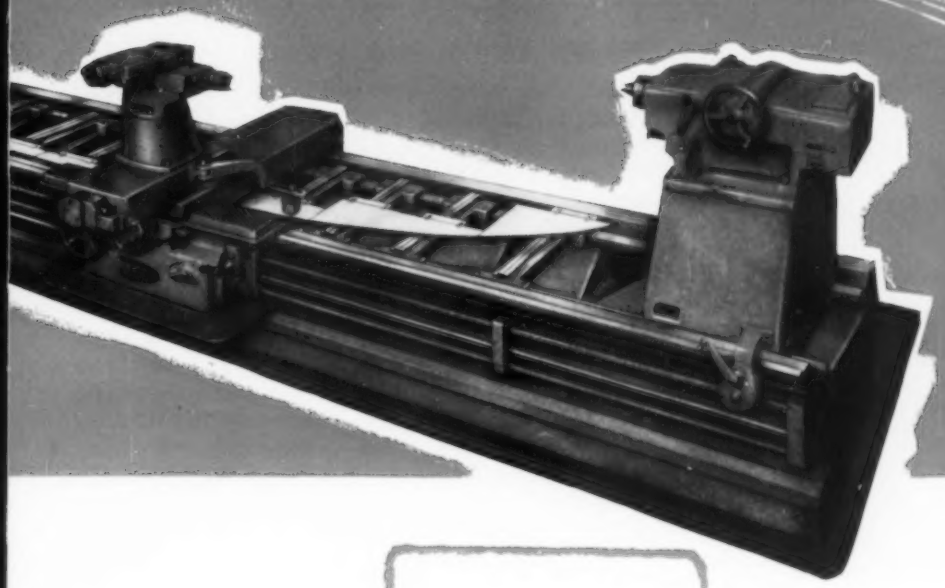
Redesigned horizontal milling, drill-in and boring machine has more compact head, centralized controls and saddle mounted entirely on bed ways. Base looks less cluttered than old model (see sketch), and hold-down and leveling bolts are now within frame. Head now has own drive, and feed is stepless for all motions of head, table, saddle and the 3-in.-dia. spindle. By industrial designers Smith, Scheer and McDermott, Akron 30, in collaboration with sales and engineering personnel of Portage Machine Co.

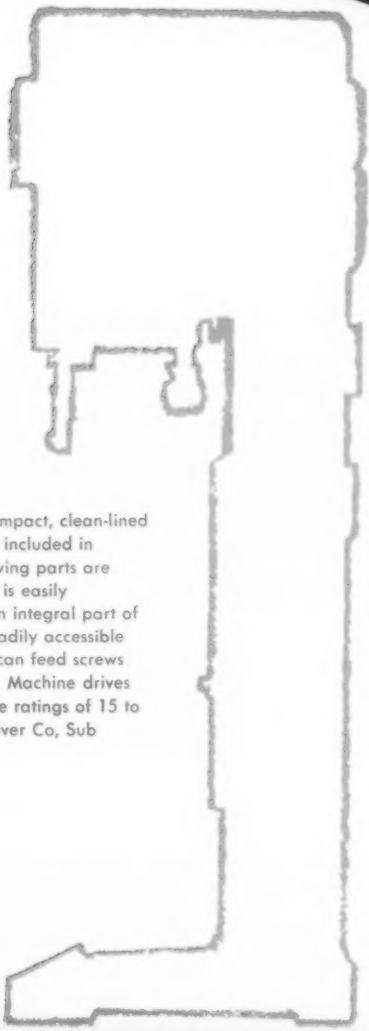


design...

. . . for the machine-tool industry

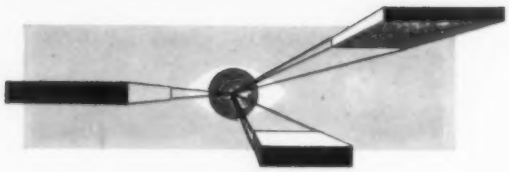






Power screwdriver retains its compact, clean-lined look whether on floor pedestal or included in automatic assembly lines. No moving parts are left exposed and actuating pedal is easily distinguishable while remaining an integral part of the base. Barrel-type feeder is readily accessible for loading and adjustment, and can feed screws either manually or automatically. Machine drives screws up to 1½ in. long at torque ratings of 15 to 120 in.-lb. Detroit Power Screwdriver Co, Sub of Link-Belt Co, Detroit 16.

Swiss-made bench micrometer has an extra-large thimble that increases user's sensitivity in manipulation. One complete turn of thimble corresponds to an advance of 0.04 in. Distance between the 100 dial divisions corresponds to linear advance of 0.001 in. Tavannes Machine Co, Tavannes, Switz.



POINTS

THE QUESTION:

> ***"What Is the Proper Balance Between Government and Commercial Work Within a Company?"***

CHARLES W. PERELLE
President
American Bosch Arma Corp

"Where a balance is desirable . . .

the choice rests with the management of an individual company, based on its degree of diversification and commercial markets. Under defense contracts the need for security safeguards and more stringent inspection makes such work more costly to perform than commercial manufacturing—and profit margins are much lower. These factors pose serious problems for a company whose production facilities are geared primarily to commercial markets.

"However, defense business will be a part of our national economy for many years to come. In this respect, we feel there is a degree of continuity in a well-balanced program of government work that can assist a company to weather wide fluctuations in its volume of commercial business. This latter situation is particularly true today of our American Bosch Division where sales of fuel injection and automotive accessory equipment have declined sharply with reduced automobile and truck production.

"We are endeavoring at American Bosch now to build an organization and skills which can handle defense business that conceivably might reach a much larger percentage of annual gross sales and which we feel will tend to level off fluctuations in demand for commercial products, and stabilize employment."

MATTHEW J. BETLEY
President
Titeflex, Inc.
Springfield, Mass.

"This can be determined . . .

by the effect on the stability of your company. Stability, which encompasses production, sales, profits, dividends, is the criterion of any mature business. This is constantly sought and the degree to which these are achieved is in part a measure of your company.

"This question of balance has no 'pat' answer. You fit the shoe to the foot and to the times with long-range planning being directed by the desire for stability. Some companies' business stems almost completely from the commercial market, while that of other companies is derived to a similar degree from government sources. It is obvious that companies in both groups can be equally successful."

OF VIEW

"In our planning . . .

we have to consider not two but three categories: military, commercial and consumer. Diversification of customers and products is desirable because it produces stability by averaging out the cycles and fluctuations that may affect one of the three market areas. Financiers seem to agree with us; we have heard that they are reluctant to make long-term loans to companies doing more than 50% of their business with the government.

"On a short-term basis, the distribution of sales is beyond our control. Obviously, we'll do our best to meet a big increase in demand for a product in any one of these groups; but long-range planning of our engineering and sales effort helps to preserve a balance. We feel that this has a number of advantages for our company and our customers. Cross-fertilization of ideas and techniques is an important one. The military sales group has to be extremely conscious of quality and reliability while concerning itself with exotic engineering that reaches into the forefronts of science. In consumer products, heavy emphasis is on low-cost quantity production; while commercial people demand versatility in addition to these other qualities. By shifting personnel from one type of operation to another, and by drawing from all three divisions for our Cost Study Group, we have benefited by a number of good ideas that are helping us to control costs. Also, our military work with advanced design adds an element of imagination to commercial and consumer products-planning, educating our engineers to consider the future uses of developments that may not even be practical at the present time."

ROBERT S. BELL
President
Packard-Bell Electronics
Los Angeles, Calif.

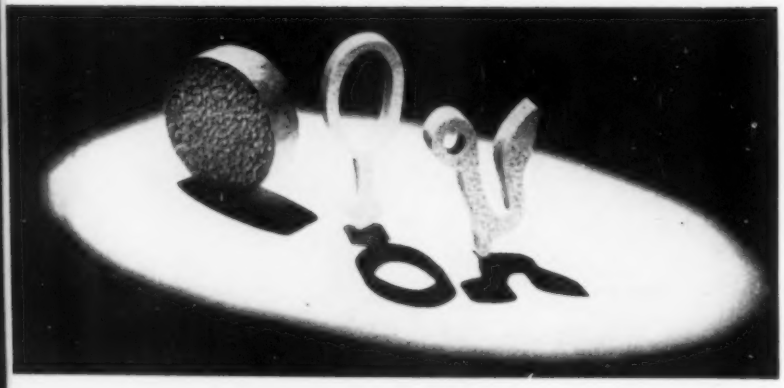
"It would be difficult . . .

to pinpoint desirable proportions of government and commercial work. At present, we are far more involved in military activities than we are in commercial production. We are striving to develop commercial markets for our processes and products on the premise that we are out of balance, and I believe that perhaps 60% commercial and 40% government might be about the proper ratio.

"Apex is pioneering in the development of significant fiberglass products for the military in centrifugal molding and filament winding. To a great extent, our future commercial business will grow out of these developments for the military.

"Naturally, any commercial advantage we can make of the research and development we have performed for the government is highly profitable. We will not, however, concentrate on the development of commercial business to the point where we would have to neglect our military activity."

JOHN A. GEHLING
Vice-president
White Sewing Machine Corp.
and General Manager,
Apex Reinforced Div



Complex silicone sponge shapes . . .

can be extruded and calendered in long lengths, continuous lengths, coils, rolls and sheets up to 36 in. wide. Calendered sheets can be combined with Orlon, Dacron, nylon, glass fiber and other heat-resisting fabrics. Parts offer temperature resistance from –160 to 500 F. Lower equipment costs coupled with high-volume production economies are said to result in lower production costs. Most special extrusion dies are reported to cost less than $100. Density, cell size and configuration are controlled to produce sponge cross-sections to close dimensional tolerances. Complies with industry standards. Samples are available. **Stalwart Rubber Co, 166 Northfield Rd, Bedford, Ohio.**

Circle 11, Reader Service Card

Preassembled spring washers . . .

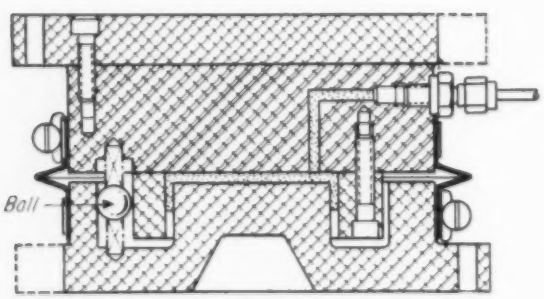
are held together by a flexible elastic covering for applications where pins or rivets cannot be used because washer walls are too narrow or where there is insufficient vertical or radial clearance for retaining rings or cores. Two types of coverings are offered: a molded rubber, neoprene or vinyl covering, which is cured around washers while they are under slight load; a dipped or sprayed latex coating, applied to stacks while they are held firmly, but relaxed. 2 to 4-wk delivery after approval of specifications. **Associated Spring Corp, Bristol, Conn.**

Circle 12, Reader Service Card

Water-cooled pressure pickup . . .

has a natural frequency of 30,000 cps with water or 40,000 cps without water. Flush-mounted diaphragm has double-spiral cooling passage for uniform cooling. In pressure ranges of 500, 1000 and 2000 psi, with overload protection of 2000, 3000 and 4000 psi, respectively. Excitation voltage is 30 v ac or dc. Full-scale output is about 1.5 milliv/v. 2⅝ in. long x 1 in. dia. Weighs 100 gm. Designed for use in rocket research, the transducer is reported to have withstood gaseous temperatures in excess of 5000 F in a copper test motor at 600-psig chamber pressure. Priced at $500, fob destination. **Dynamic Instrument Co, Inc, 42 Carleton St, Cambridge 42, Mass.**

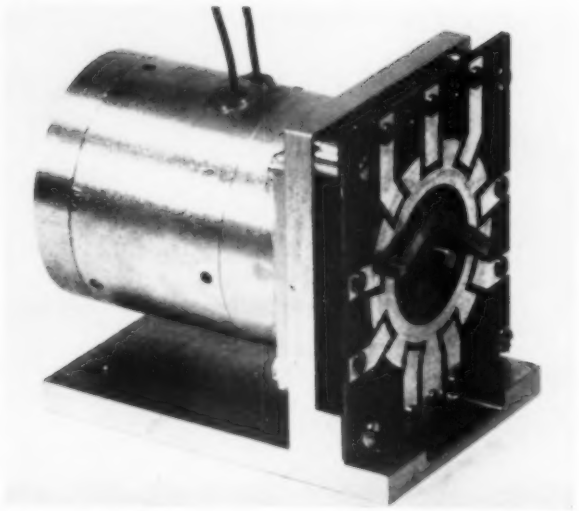
Circle 13, Reader Service Card



Low-capacity load cells . . .

have molded rubber diaphragms and piston-positioning devices consisting of three stainless steel balls. Accuracy is said to be well within ¼ of 1% of range. Cells withstand cross-loads resulting from expansion and contraction of tank. Load capacity is in 0 to 1000-lb range. Line includes special cell with rolling ball head. Cells are applicable to customer-engineered weighing systems and can be installed by the user. Compression cell is $250, with other units ranging to $450. From stock. **A H Emery Co, Pine St, New Canaan, Conn.**

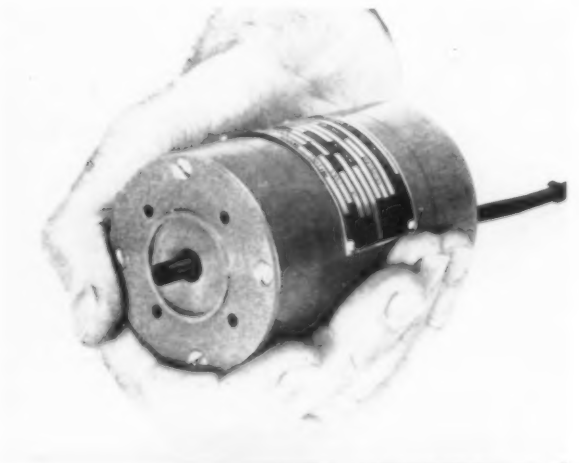
Circle 14, Reader Service Card



Stepper motor . . .

steps nine times per rev, locking shaft mechanically except when coil is energized and shaft rotates (shaft relocks automatically). Motor is 1¼ x 1⅜ in. long; weighs 4.5 oz. Torque and stepping rate depend upon power available to operate motor. At 17.5w input, unit produces 2.5 oz-in. torque and follows a 25-cps pulse with a low-torque, low-inertia load. Switches, rated 100 milliamp at 28 v dc. Life of motor is said to exceed 24 million steps. About 8 to 10-wk delivery. **Globe Industries, Inc, 1784 Stanley Ave, Dayton 4.**

Circle 15, Reader Service Card



Lightweight intermittent-duty motor . . .

delivers 1 hp at 22,000 rpm. Produces 1.75 hp max. The 400-cps, 208v, 3-phase ac motor was developed for rocket, missile applications. Weighs 2¾ lb. Dimensions are 4 in. long x 2½ in. dia. Shaft is ¼ in. dia x ½ in. long. Available from stock. **Hoover Electric Co, Hangar 2, Port Columbus Airport, Columbus 19, Ohio.**

Circle 16, Reader Service Card

Switch in floor mat . . .

consists of a grid of strip switches interconnected and sealed between flexible vinyl sheets. Mat, less than 1/16 in. thick, may be used exposed or can be placed under a rug or runner. May be tacked down or cemented. Unaffected by moisture. Said to be able to withstand repeated hammer blows. Supplied in 23-in. widths to any length. For annunciator, alarm and controlling applications operating at 30 v ac or below. Mat, 23 x 16 in., is $8.50 in small quantities. From stock. Continuous lengths sell for about $5 per ft in small quantities 4-wk delivery. **Tapeswitch Co of America, 116-46 228th St, Cambria Heights 11, N Y.**

Circle 17, Reader Service Card

Shaft-mount gear motor . . .

has a hollow output shaft, replacing handwheels, cranks or levers. Permits remote or automatic control as an optional feature on original equipment. Gear reductions of two to four stages with ratios from 80:1 to 1600:1 are offered. Available models deliver 75 to 800 in.-lb. Gear trains and induction motor are lubricated by individual oil systems. Standard units are single phase, 110 v. Can be furnished in explosionproof housing to NEMA specifications. Separate gear train drives built-in potentiometer so that full-scale movement is obtained with from 90 to 450° on output shaft, with ⅛ to 40 rev for other models. Said to be about ½ cost of previous models delivering same torques and speed. **Jordan Co, 3235 W Hampton Ave, Milwaukee.**

Circle 18, Reader Service Card

Teflon retaining seal . . .

is used in conjunction with a standard O-ring. Applications include high-frequency, low-amplitude, high-response mechanisms; mechanisms that must operate first time with min break-out friction; standby machinery that must operate freely after prolonged periods of inactivity; long-life equipment where dismantling for seal replacement is exceptionally costly; throw-away components where long-life seals make enclosed design possible; fingertip control and solenoid-operated mechanisms; also to provide effective sealing on continuously operating mechanisms. In one style, it is used in installations where friction surface is applied to ID of seal; in another, OD is sealing surface. Sizes range from 0.125 to 7.750 ID for former; 0.250 to 7.750 OD for latter. Prices range from 8 to 20¢, depending on size and quantity. 3 to 4-wk delivery. **Minnesota Rubber Co, 3630 Wooddale Ave, Minneapolis 16.**

Circle 19, Reader Service Card

Miniature edgewise meter . . .

fits hole ⅞ x 1 1/16 in. Said to give performance and readability of 2½-in. sizes. Incorporates self-shielded magnet and is not affected by magnetic panels. Has high torque, accurate movement. Weighs 4 oz. **Triplett Electrical Instrument Co, Bluffton, Ohio.**

Circle 20, Reader Service Card

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Our engineering service includes not only a thorough analysis of your parts, but also a careful study as to the type of cloth best suited to your needs.

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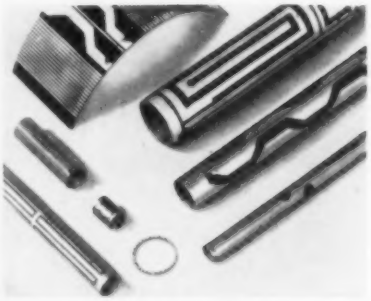
351 Verona Avenue • Newark 4, New Jersey

SIGNIFICANT COMPONENTS
MATERIALS
PROCESS . . .



Printed circuits on tube . . . exteriors or interiors, or both, may be applied to almost any type of nonconducting material. Generally, conductive inks are deposited from 0.0004 to 0.0015 in. thick, depending upon requirements. Pattern tolerance can be held, under some circumstances, to 0.001 in. Circuits are said to be stable to 500 F. ½ in. ID is usually required for circuitry but continuous coatings for shielding or conduction have been applied to tubes of 0.020 in. ID. No limitation on length. Direct-printed tubes have been used as instrument housings, resistors, capacitance-type fuel gages, probes. **J. Frank Motson Co., Flourtown, Penna.**

Circle 21, Reader Service Card

Lubricator-filter-regulator . . . combination protects pneumatically operated equipment. Lubricator has flexible operating range because adjustments can be made for high- and low-cfm applications. Acceleration of air forms oil mist as it passes through a venturi, rather than

EMPLOYMENT

SIGNIFICANT COMPONENTS

back or air pressure. Therefore, it delivers oil only on application of air. Max cfm at 90 psi is from 40 to 100 cfm. Air filter separates heavier-than-air particles by centrifugal motion and filters air further through two dutch weave Monel screens. Will function only in intermittent air flow. Max cfm at 90 psi is from 20 to 70 cfm. Pipe sizes for the units range from ¼ to ½ in. with max inlet pressure of 250 psi. Available for immediate shipment. **EMCO Pneumatic Corp, 1317 Locust St, Des Moines, Ia.**

Circle 22, Reader Service Card

Reversing manual valve . . . is actuated by push-knob. For up to 200-psi pneumatic and hydraulic or vacuum service. Reverse action is imparted by a standard spring return end section, mounted on any standard two, three or four-way manual valve body, in sizes from ¼ through ¾ in. NPT. Standard max panel thicknesses range from ⅜ in. for ¼-in. NPT valves to 1½ in. for ¾-in. NPT types. Valves have one-piece Navy M bronze bodies, hard-chrome plated stainless steel stems. Flow area through valve is said to be equal to nominal pipe size. **Valvair Corp, 454 Morgan Ave, Akron 11.**

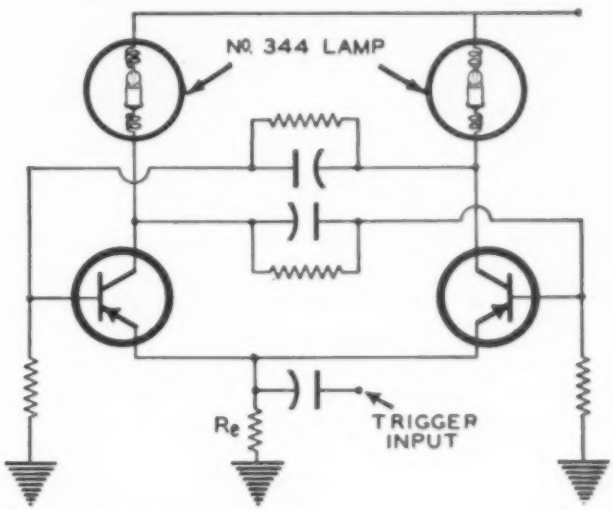
Circle 23, Reader Service Card

Transistor photoelectric control . . . functions at 300 operations/min. Heavy-duty unit consists of control panel, light-source holder and photocell holder. Operates at lightbeam distances up to 8 ft. Life expectancy of the hermetically sealed, plug-in, transistor-equipped relay is said to be over 20 million operations when used to control devices such as a small electromagnetic counter. Circuit design produces snap-action closing of output relay contacts, which are rated 5 amp max. Control is 9 x 6 x 5 in.; light source, about 3¾ x 1¾ in.; photocell holder, about 2¼ x 1¾ in. Control panel also supplies power to light source, eliminating additional power supply. **General Electric Co, Schenectady 5.**

Circle 24, Reader Service Card

General Electric announces new "VERY LOW CURRENT" lamp for use as indicators for transistorized circuits

A possible use: as an indicator on a flip-flop circuit.



GE-344 incandescent lamp is rated at 10 volts, 15 milliamperes; has life in excess of 5,000 hours

Twice actual size

General Electric's new GE-344 is designed for use in transistor circuits and many other applications where a small sized, low current indicator lamp is needed. Only 7/32" in diameter, 5/8" long, the GE-344 can be seen lighted under 100 footcandles of surrounding light. It uses only .15 watts (nominal), has a single contact midget flange base, and its electrical ratings allow significant savings in providing an indicator light in transistorized equipment. For additional engineering data on this new GE-344 lamp, write: General Electric Co., Miniature Lamp Dept. PE-88, Nela Park, Cleveland 12, Ohio. Ask for Bulletin No. 3-8066.

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GENERAL ELECTRIC

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ENGINEERING OPPORTUNITIES

Progressive, medium-sized, multi-plant organization located in Central Connecticut has several positions available for qualified Project Development Engineers and Machine Design Engineers. Previous experience in the development or design of medium to heavy automatic and special machinery essential. Typical experience would be as a development engineer or machine designer on packaging or metal stamping machines or similar types of mechanisms.

The Emhart Manufacturing Company is a Connecticut organization consisting of the following well-known companies: Hartford-Empire, Standard-Knapp, Skyworker, V & O Press and Maxim Silencer. As a diversified manufacturer, our machine products are leaders in the field of glass making, automatic packaging, automatic press and special machinery, and hydraulic aerial lifts.

M. E. degree preferred.

Send resume stating background, experience and salary requirements to:

Personnel Department

EMHART MANUFACTURING COMPANY

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Now available in a *new edition* . . . with *new figures.*

This popular booklet points up the important sales problem of personnel turnover in industry. Out of every 1,000 key men (over a 12-month period) 343 new faces appear . . . 65 change titles . . . 157 shift . . . and 435 stay put. These figures are based on average mailing address changes on a list of over a million paid subscribers to McGraw-Hill magazines.

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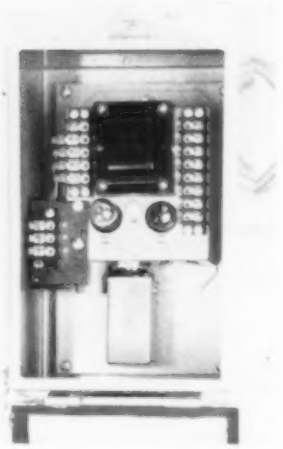
When answering the classified advertisements in this magazine don't forget to put the box number on your envelope. It's our only means of identifying the advertisement you are answering.

SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .



Proximity limit switch . . . detects magnetic materials through an air-gap up to 1 in. Electronic switch incorporates a differential transformer transducer as sensing device. When a ferromagnetic object passes within range, a signal is generated that actuates control relay. Sensor housing is sealed and potted and is shielded from stray magnetic fields. No calibrated transmission cables nor special power supplies are necessary. Package, ready for installation, includes sensor head, printed-circuit control relay with set point adjustment and plug-in 6-conductor cable connector. Unaffected by line voltage variations of 10%. Relay is rated at 115 v, 60 cps. **Automatic Timing & Controls, Inc, King of Prussia, Penna.**

Circle 25, Reader Service Card

Flow calculator . . . is a double-faced, 6-in. dia, made of vinyl plastic. Provides readings of flow, pressure drop, orifice sizing for air and liquids with about 15-in. linear slide rule accuracy. Price, $3.75. **Eckel Valve Co, 1425 First St, San Fernando, Calif.**

Circle 26, Reader Service Card

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This index is published as a convenience to the readers. Every care is taken to make it accurate but PRODUCT ENGINEERING assumes no responsibility for errors or omissions.

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NEW LITERATURE

The Rise of Modern Physics

C. F. Von Weizsacker and J. Juilfs. Published by George Braziller, Inc, 215 Fourth Ave, New York 3. 5x8, 150 pp. $3.75.

In this book, two world renowned scientists present the concepts of classical physics and tie together many new developments in contemporary physics.

Higher mathematics are not required to grasp the great strides that modern physics has made. In fact, the material is presented in a way that one can sit back in an easy chair and enjoy the reading.

The book follows the traditional approach—its divisions are derived partly from sense perception (heat, light, sound), partly from general concepts (mechanics, theory of relativity), and partly from the subject matter itself (electricity, atomic physics). It discusses the three elementary "particles" that make up the physical world, matter, electromagnetism, gravitation; and the attempts of physicists to tie the three together.

The more interesting chapters include those on atomic physics—interesting because as modern materialistic philosophers believe that all reality is in the interplay of these atoms. The authors present the latest concepts of the atomic nucleus and discuss experimental equipment such as particle-accelerators, cyclatrons and betatrons. —NC

Outboard Motors

The horsepower race and other significant developments in the design of outboard motors are described. Detailed illustrations of present-day models are included, along with their principal mechanical innovations.

Abstracted from "Outboard Motors—Their Present and Future"; Lubrication, June '58, Texas Co, 135 E 42nd St, New York 17.

Industrial Sociology

EUGENE V. SCHNEIDER, *Bryn Mawr College. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. 6½ x 9¼, 559 pp. $6.75.*

This book depicts the social structure of large-scale industrial organizations, analyzing relationships between parts and the roles of individuals who work within this type of social structure. The development of unions and their function in industrial societies are discussed and the ways in which industry affects, and is affected by, the local and national community are described.

As background reading and preparation for executive responsibilities, this book should be of value to the engineer. However, the role of engineering and related technical staffs in the industrial social structure is virtually ignored. This is a serious weakness and indicates a lack of balance in the approach taken to today's technological society. —JK

RESEARCH TO MANUFACTURING—Brochure, 36 pp. Covers facilities for research, development and manufacturing of products that range from missile instrumentation to heavy metalforming press equipment. Lists major equipment available for contract manufacturing at various divisions. US Industries, Inc, 6201 W 63rd St, Chicago 38.

Circle 1, Reader Service Card

ZINC SPOTLIGHT—Newsletter, 4 pp. A new quarterly about zinc and zinc industry. To cover product research, design, production, applications. May be obtained without charge. American Zinc Institute, Inc, 60 E 42nd St, New York 17.

Circle 2, Reader Service Card

VISUAL PRESENTATION—Catalog, 32 pp. Describes and illustrates 435 pressure-sensitive materials in tape, rectangle and sheet form for graphic arts, circuits, shop plans, engineering drawings. Chart-Pak, Inc, Leeds, Mass.

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BASIC SWITCHES—Catalog 620, 32 pp. Gives details of more than 200 listings. Operating characteristics, dimensional drawings, photos and electrical ratings. Micro Switch, Freeport, Ill.

Circle 4, Reader Service Card

INDUSTRIAL FILTERS—Master catalog (consists of industrial catalog, 20 pp; general-products catalog, 16 pp; air-filter catalog, 36 pp; filter-specifications catalog, 76 pp). Contains illustrations, diagrams, dimensions, specs, curves and descriptions of filters and filtering equipment for engines and industrial applications. Filter-specs catalog includes extensive cartridge cross-references. Fram Corp, Providence 16, R. I.

Circle 5, Reader Service Card

METAL FABRICATORS—Brochure, 36 pp. Pictorial presentation of facilities available and products. Paul Mueller Co, PO Box 150, Springfield, Mo.

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Publisher's Postscript...

Miniaturization

Not yet in most dictionaries—actually a made-up word—miniaturization has been an important product-design goal since World War II. Everybody needs a product or a component that will perform as well, last as long, cost no more, yet be half or even one-tenth the original size.

To miniaturize you can't just scale down to some convenient pinhead size. Manufacturing problems, and the need to put out the same force, torque, light, voltage or what-have-you require ingenuity, imagination, original thinking and solid design experience—sometimes far beyond what the original large-scale prototype required.

Yet the accomplishments have been amazing. In almost every field of product design, the best engineering brains have designed out bulk—transistors, of course, and later, computer modules and circuits, radios and TV sets (and TV tubes), limit switches, valves, air conditioners, electric motors, business machines—the list is endless.

Our editors have been reporting this progress to you week after week. You have followed the developments in aircraft, missiles and rockets and how these developments might, and later have, been applied to consumer products.

And the effort is contagious. Maybe we shouldn't call it miniaturization, but the editors are just as concerned with designing out bulk as engineers are. After all, our editors are engineers too, and original information or reports taking reams of paper must be condensed into a tiny fraction of the original space if it is to be worth the engineer's precious time.

For example, just recently we published a series of three 5-page articles on "Sandwich Panel Materials." The original data were over 100 typewritten pages, plus tables and photographs. Condensed and rewritten for publication these data were reduced to one-third of the former size. Yet no important factual information was left out. The printed articles had the same value to you as the manuscript prototype. That's miniaturization applied to good reporting.

Another illustration: The article on "Selecting Polyphase Motors" in the August 18 issue appears in 4 pages, but it would have taken 20 of our pages plus tables if printed as received.

Both these examples are available in reprint form. Send for them by writing the titles on the card facing this page and see if they don't give you what you need to know now in a minimum of space.

When you look at our masthead and note the many editors working full time to produce this publication, perhaps you wonder what they all do. Miniaturization is their job. You read only the find version of articles and news stories that are written and rewritten—condensed to require a minimum investment of your reading time. The real effort is invisible—as it should be. —A.H.

For Your Information (personal)

Catch up with the past

For $895, you can build yourself a hunk of nostalgia and go tootling off down the road. That's the knocked-down price of the latest thing in automobiles: the "Surrey," marketed by Dyer Products Co, Canton, Ohio.

This near-perfect replica of the 1903-model car has a tiller instead of driving wheel, polished brass headlights, wooden-spoke wheels and rear-wheel brakes, a 4.8-hp engine, and a 2-gal. gas tank. It meets modern highway regulations, though, and runs on standard Goodyear Studded Tread bicycle tires. Top speed: 35 mph (65 miles to a gallon).

Fully assembled, the car is priced at $1,095, will be sold through franchised automobile dealers.

Built-ins that aren't

Keeping up with the Joneses' kitchen can be pretty expensive these days. The big trend is toward built-in equipment, and that rarely comes cheap. But for people with built-in ideas and a free-standing budget, manufacturers are now readying a group of simulated built-ins that look mighty like the real thing (*PE—June 16, p 5*).

Sears Roebuck, for instance, offers an 11.5-cu ft refrigerator that matches, and will rest on, a work-level cabinet—and look as if it's there to stay.

Tappan has a hang-it-on-the-wall, 4-burner range-and-oven combination (the oven above work level, the burner shelf at work height) that's said to offer all the standard features plus automatic roast control, a built-in rotisserie and an automatic timer. Both units are priced in the "popular" class: the refrigerator at about $380, the range at $550.

(Tip to prospective range buyers, and particularly those who are planning to install a separate oven: arrange it so the level of the open door is about 3 in. below the little woman's *elbow height*. A study by Cornell University's Department of Household Management shows elbow level is a much better datum point than any keyed to over-all height.)

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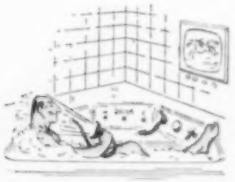
WHY DON'T THEY RESEARCH and DEVELOP...



. . . something new in bathroom equipment? Bathtubs. for instance, haven't really changed in decades. How about a sprayer-hose attachment similar to those used in the kitchen sink for hard-to-get-at dishwashing? Hose would disappear into wall when not in use. Another suggestion: drain and flow inlet should be handled by a series of holes around inner periphery to swirl and thoroughly mix water, thereby easing cleaning, as all sides would be washed down by rinse flow. Bottom of tub should have nonslip finish—rubber inserts or what have you. Add built-in pushbutton dispensers for water softener, bubble bath, soap, shampoo to eliminate array of breakable bottles around the tub. —B. MARIE

. . . a direct-reading flowmeter (calibrated in fps) for open tanks. The measuring head should be freely movable and respond only to local flow rate so that flow in all directions, including turbulence, could be measured. Instrument should be portable and have meter face near handle for easy reading. —H. J. BATES

. . . a tractor seat that would stay comfortably level on hillsides. Note that controls would have to be specially designed for this kind of operation. —R. C. GASTON

. . . an additional typewriter key to eradicate mistakes. In retracted position it might be immersed in a quick-drying ink dissolving solution. A second, blotting key may also be needed. —F. P. BRUNO

Have you a pet project but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer

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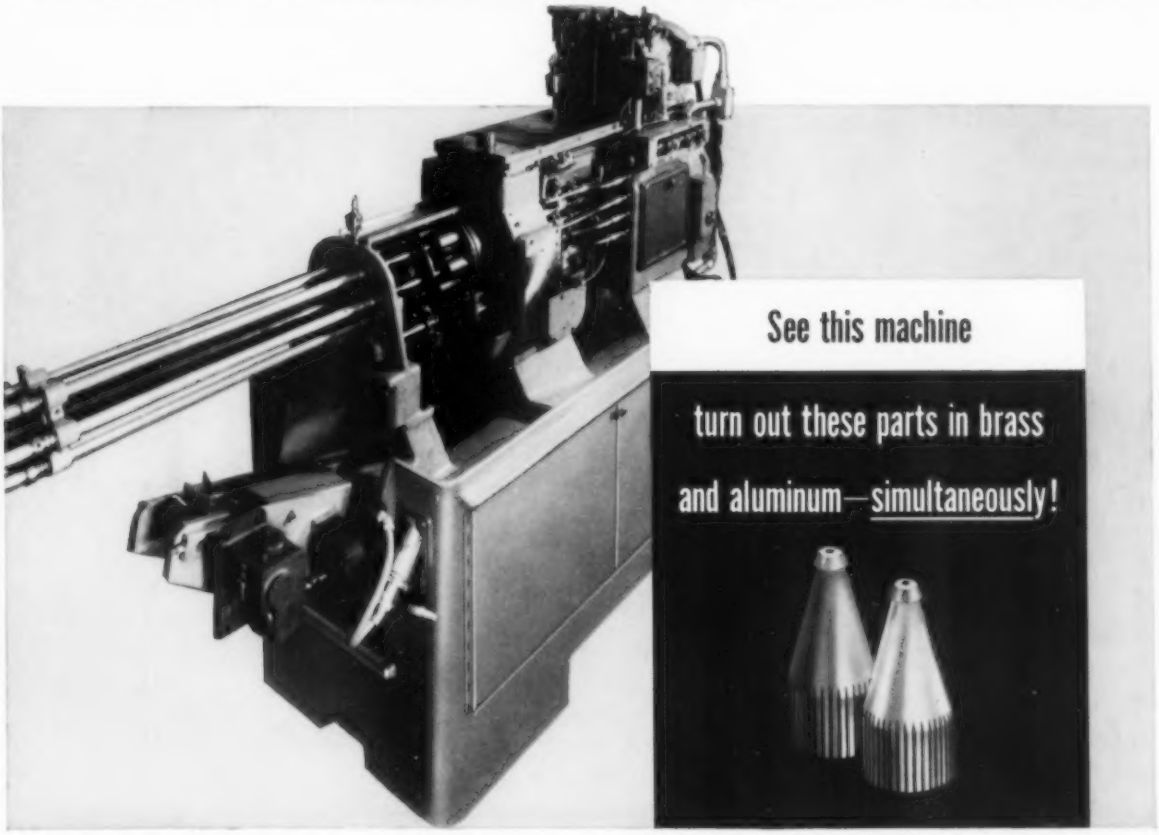

See screw machine parts produced in aluminum at less cost than steel or brass

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